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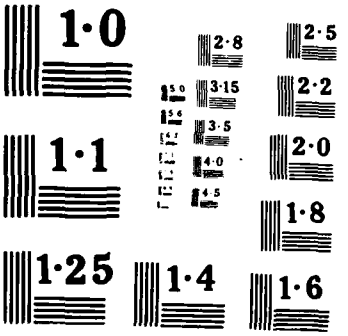
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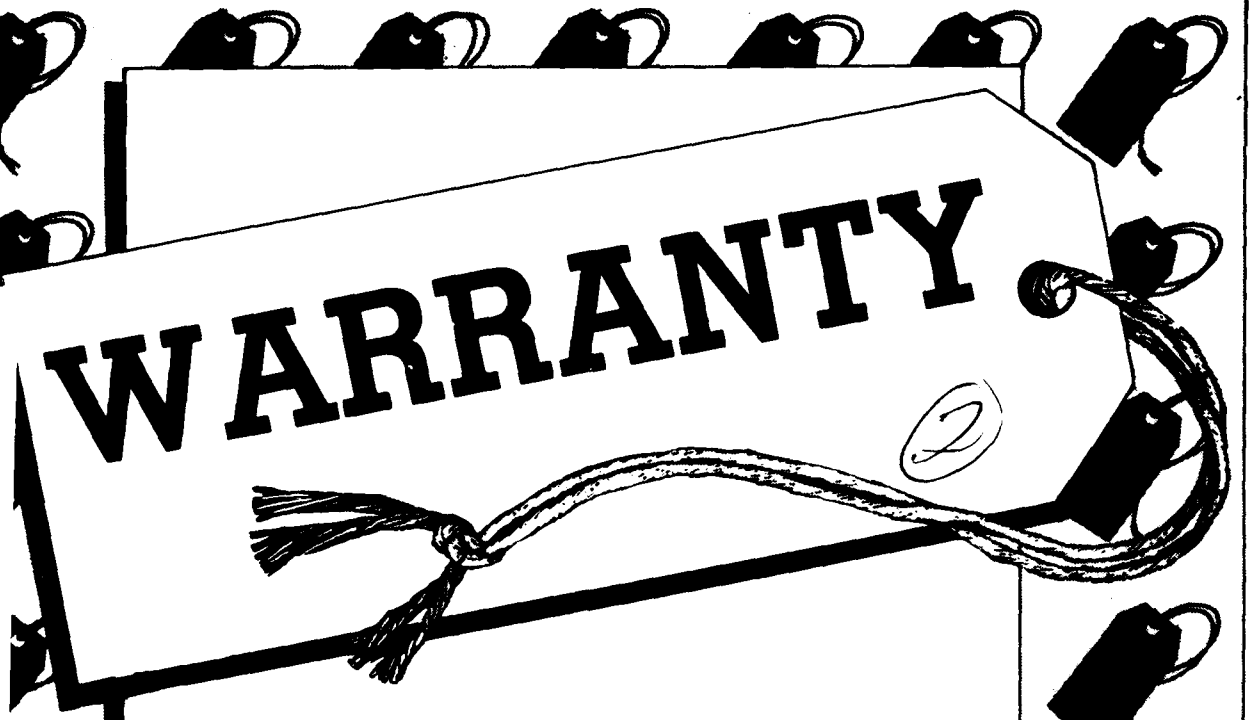

WARRANTY HANDBOOK

A REFERENCE GUIDE FOR USE BY DOD MANAGERS IN DEVELOPING, APPLYING, AND ADMINISTERING WARRANTIES

DEFENSE SYSTEMS MANAGEMENT COLLEGE
FORT BELVOIR, VIRGINIA
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Final Report
WARRANTY HANDBOOK

June 1986

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PREFACE

Title 10, Section 2403, of the United States Code requires that a warranty be included in procurement contracts for weapon systems. This has generated a great deal of concern from both military and industry. Questions such as the following have been asked:

- How can complex military equipment be warranted?
- How much should a warranty cost?
- What are the potential benefits?
- Can reasonable terms and conditions be developed?
- Can a military warranty be administered effectively?
- Will industry respond?
- Will the military user adapt?
- What tools are needed? What tools are available?

The Department of Defense and the military services have addressed these types of questions through policy directives, guidance documents, research contracts, workshops, and warranty focal points. However, the nearly all-inclusive nature of the warranty law, imposed without much time for phase-in, has presented a severe challenge to the military contracting office, program office, and logistics community to secure and implement effective warranties at a reasonable price. Contractors face similar challenges: They are now required to warrant (1) that delivered equipment conforms to the design and manufacturing requirements, (2) that the equipment is free from defects in materials and workmanship, and (3) that deployed systems will meet specified essential performance requirements.

This handbook is designed to aid program managers of all the military services in meeting the requirements of the warranty law. The handbook addresses a wide range of topics, from warranty acquisition strategy, to development of terms and conditions, through planning for the operational phases. In the past, there were few contractual controls available to the Government to ensure that an accepted product maintained its specified characteristics in the user environment. Developing and implementing a warranty that provides assurance that deployed equipment meets requirements, that does not add appreciably to acquisition cost, and that does not impose unacceptable risks on the supplier is a challenging task. It is hoped that this handbook will provide material to help meet that challenge.

This handbook was developed by ARINC Research Corporation, Annapolis, Maryland, under Contract MDA903-85-C-0320 directed by DSMC. The principal authors were Harold S. Balaban, Kenneth B. Tom, and George T. Harrison, Jr. Editing services were provided by Sheryl Sieracki. A number of Government and industry personnel provided assistance through interviews, background material, and consultation. Special mention is made of the following organizational representatives who, with their associates, performed a detailed review of the final draft of this handbook: Ronald Bulmer (OSD), Norman Freeman (Army), Ted Thompson (Navy), Thomas Brown (Air Force), and John Max (PPAC). The authors would like to thank all participants and the personnel and faculty of DSMC, whose guidance and suggestions were most helpful.

The Defense Systems Management College is the controlling agency for this handbook. Comments and recommendations related to this handbook's contents are solicited.

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June 1986

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INTRODUCTION

1.1 PURPOSE

This handbook is a reference guide for military program managers who are tasked with including a warranty provision in system or equipment procurement contracts as required by law. It includes warranty applications that are designed to meet the current statutory requirements as well as more extensive forms of warranty. The handbook is also designed to be used as a text by the Defense Systems Management College to train program management personnel in warranty development and application.

1.2 SCOPE

This handbook addresses the actions to be taken to effectively meet the requirements of Title 10, Section 2403, of the United States Code (herein referred to as 10 USC 2403), which, in general, requires that warranties be secured for all weapon system procurements. The handbook is applicable to all the military services. To meet the requirements for effective warranty application, it is necessary to consider activities ranging from developing acquisition strategy through planning for the operational phase of the system life cycle.

Warranties in military procurement contracts are not new. However, 10 USC 2403 requires specific types of controls while offering latitude to program managers to narrow or broaden the scope of the warranty coverage as deemed necessary for effective application. The handbook focuses on the law's basic provisions, but for completeness, it addresses more extensive forms of warranty such as represented by various incentive types of product performance agreements (PPAs), including reliability improvement warranty (RIW), mean time between failures (MTBF) guarantee, and logistics support cost guarantee (LSCG).

1.3 USE

No handbook can replace good judgment, experience, and hard work. However, this handbook is designed to enhance such attributes by containing reference material, data, case examples, lessons learned, development guidelines, and supporting appendix material. The size of the handbook has been kept to a minimum to provide material in a concise manner, yet the handbook is complete enough to set the warranty program on the right course. Since decisions made during the acquisition phases can affect the remaining system life cycle, the program manager or designee should read the complete document at least once before embarking on a warranty development program. In that way, there will be a better understanding of long-range impacts of early warranty decisions. Such understanding is mandatory if a program manager is to do the job well.

1.4 SUMMARY OF CONTENTS

The remaining chapters of this handbook are summarized as follows:

- *Chapter Two – Warranty Law and Department of Defense Policy*: Provides background information on acquisition controls and a short history of warranty in military procurement; provides details on the current warranty law applicable to weapon system procurements; reviews Department of Defense (DoD) guidance for implementing the law; presents a summary of military service focal points; and describes the Product Performance Agreement Center (PPAC).
- *Chapter Three – Warranty Concepts and Issues*: Presents basic definitions associated with warranties; identifies two basic warranty classifications – assurance and incentive; discusses incentive forms of product performance agreements; and

addresses warranty issues, including conformance determination, remedies, acquisition, costs, and risks.

- *Chapter Four—Warranty Selection and Structure*: Describes acquisition, system, and operational factors that influence warranty decisions; discusses major warranty alternatives; describes the elements normally included in a warranty; and summarizes warranty forms applicable to various system classes.
- *Chapter Five—Warranty Development*: Addresses warranty impacts on the acquisition strategy and procurement plan, system specification, and program office organization; and presents specific recommendations for warranty development for each phase of the acquisition cycle, including studies, requirements, RFP development, proposal evaluation, and final negotiations.
- *Chapter Six—Warranty Administration*: Addresses preparing for, administering, and evaluating the warranty; making decisions on concluding or extending the warranty; and assessing the benefits of the warranty.
- *Chapter Seven—Warranty Cost-Benefit Analysis*: Discusses requirements for and approaches to conducting warranty cost-benefit analyses; presents a generalized warranty cost-benefit decision algorithm; discusses warranty cost elements and warranty benefits; and summarizes available models to aid in performing cost-benefit analyses.
- *Chapter Eight—Case Examples*: Presents a brief summary of several previous and current warranty programs, including contract background, warranty coverage, remedies, and the essential performance guarantee.
- *Appendix A—Glossary of Terms*
- *Appendix B—List of Acronyms and Abbreviations*
- *Appendix C—Title 10, Section 2403, of the United States Code*
- *Appendix D—Defense Federal Acquisition Regulation Supplement (DFARS) Subpart 46.7*
- *Appendix E—References*

Chapter Two
WARRANTY LAW AND DEPARTMENT OF DEFENSE POLICY

This chapter addresses current law and DoD policy regarding warranties. It provides background information on the concept of warranty, discusses acquisition controls, presents a short history of warranty in military procurement, provides details of the current warranty law applicable to weapon system procurements, reviews DoD guidance for implementing the law and lists service focal points, and describes the Product Performance Agreement Center.

2.1 WARRANTY BACKGROUND

The term "warranty" is defined in Federal Acquisition Regulation (FAR) Subpart 46.701 as "a promise or affirmation given by a contractor to the government regarding the nature, usefulness, or condition of the supplies or performance of services furnished under the contract." The terms "warranty" and "guarantee" are used interchangeably by the Department of Defense.

Until the passage of Public Law 98-212 as part of the Defense Appropriations Act of 1984, the use of warranties in military procurements was not mandatory. However, warranties have frequently been used by all military services; some have been quite extensive with regard to coverage, risks, and cost. In addition, there are a number of other controls on quality and performance that are commonly used and, in a sense, complement the use of warranties as mandated by the most recent warranty legislation. These controls and earlier warranty experience are reviewed in the following sections.

2.2 ACQUISITION CONTROLS ON QUALITY AND PERFORMANCE

2.2.1 Requirements, Inspection, and Acceptance

It is Government policy to ensure that contracts include inspection and other quality requirements, including warranty clauses, that are determined necessary to protect the Government's interests (FAR 46.103). In military procurements, quality and performance requirements are normally established through specifications contained in the Statement of Work. Applicable standards and specifications are invoked to provide detailed procedures to ensure that the quality and performance requirements are satisfied. This is generally accomplished through various types of inspections and tests normally performed by the contractor or, in special cases, by the Government.

Acceptance by the Government acknowledges that the supplies conform with applicable contract quality and performance requirements. Generally, acceptance by the Government is conclusive except for latent defects or fraudulent actions by the contractor, or as otherwise provided in the contract. Thus, for a typical procurement of supplies, the Government specifies its requirements and validates that they have been met through the inspection and acceptance process.

2.2.2 Latent Defects

A defect is a condition or characteristic that is not in compliance with the contract requirements. A latent defect is a defect that exists at the time of acceptance by the Government but does not manifest itself until sometime after acceptance. The purpose of including a provision for latent defect in a warranty is to provide remedies to the Government when a defect exists in an offered product that reasonable testing and acceptance procedures are not capable of detecting.

In theory, if a product evidences a defect after acceptance, and it can be "proven" that the defect was there at time of acceptance, the burden for correction or replacement is on the contractor. In practice, providing such proof can be difficult. For example, consider a truck tire, purchased by the Government,

that experiences a blowout after only several miles of use. A failure analysis may show that a tread separation caused the blowout, which was not likely to have occurred as a result of the limited use. On the other hand, consider a tire on a Navy carrier-based airplane that has been used for months and experiences a blowout after a particularly hard landing. It would be much more difficult to prove that the second tire had a defect at time of acceptance. A warranty clause can alleviate such uncertainties regarding latent defects by making clear the conditions under which a warranty claim can be made, irrespective of the condition of the product at time of acceptance. This issue is discussed further in Section 2.4.2.3.

2.3 A BRIEF HISTORY OF MILITARY WARRANTY

2.3.1 1960 to 1980

In 1964, Section 1-324 of the Armed Services Procurement Regulation (ASPR) was issued, containing regulations on the use of warranties. The section, which has been updated periodically, has been generally interpreted to mean that use of an extensive, long-term warranty should be the exception rather than the rule. For commercial items, the military normally obtains a standard warranty if the planned usage of the item is consistent with normal usage (see FAR 46.709).

Early Government controls against acquiring defective material included warranty control against latent defects. In the late 1960s and early 1970s, more extensive warranty forms were tried, such as on the Navy F-4 gyro (failure-free warranty [FFW], Reference 1) and the Air Force ARN-118 TACAN (reliability improvement warranty [RIW], Reference 2). Indications of potential success for these selected programs encouraged the Office of the Secretary of Defense (OSD) and the services to enter into a "trial period" for more extensive warranty forms, particularly RIW and MTBF guarantees. During the mid-1970s, these types of warranties were secured on such equipment as nine line replaceable units (LRUs) on the Air Force F-16, as well as the Army ARN-123 radio and Lightweight Doppler Navigation System, and the Navy APN-194 altimeter. In addition, a dialogue was begun between industry and DoD concerning the warranty issue as newer and more extensive warranty forms were being implemented by all the military services. The services supported research studies to evaluate those warranty applications and to develop analysis and implementation tools (References 3, 4, 5, and 6). After evaluating a number of these early warranty programs, researchers have concluded that a properly structured and implemented military warranty can offer significant potential for achieving desired operational performance at reasonable cost. Chapter Eight presents an analysis of relevant data.

By the beginning of the 1980s, the use of warranties in the acquisition of military systems became a "standard" option, but it was only selectively applied and usually required a special effort on the part of the program office to develop and implement.

2.3.2 Warranty Initiatives in the 1980s

The successful use of such warranty forms as MTBF guarantees and RIW during the 1970s provided a basis for extending warranty applications to a broader class of programs.

In 1980, the Air Force issued the first Product Performance Agreement Guide, which provided a summary of the features of various forms of warranties that could be used in military procurements. The Guide was revised in 1985 (Reference 7). In 1982, the Product Performance Agreement Center (PPAC) was established to provide a focal point for Air Force use of product performance agreements and warranties. Also in 1982, the Department of Defense issued a set of initiatives, which became known as the Carlucci Initiatives, to improve and streamline the acquisition process. They included warranties as one means of achieving desired levels of system reliability and maintainability.

Congressional interest in warranty as a means of ensuring acceptable field performance started with the passage of Public Law 98-212, which was part of the 1984 Defense Appropriations Act. That law, implemented by DoD policy guidance dated 14 March 1984, mandated that warranties be included in the production contract. The law, with some modifications, was made permanent by inclusion of the 1985 warranty law in the 1985 DoD Authorization Act. Passage of these laws led to increased activity in warranty research (References 8 and 9).

2.4 CURRENT WARRANTY LAW

2.4.1 Overview

The DoD [illegible] (Public Law 98-525), [illegible] established Title 10, Section 2403 [illegible] Code, entitled

"Major Weapon Systems: Contractor Guarantees." It is reproduced as Appendix C of this handbook. The law requires that the prime contractor for a production weapon system provide written guarantees, starting with procurements after 1 January 1985. It delineates the types of coverage required, lists the possible remedies, and specifies reasons for securing a waiver and actions to be taken in the event a waiver is sought. The law also provides some relief for full coverage for new items and suggests that guarantees be tailored to the needs of the procuring agency and weapon system user. Table 2-1 summarizes the essential features of the law.

In conjunction with the passage of 10 USC 2403, the Department of Defense issued a guidance document in the form of a revised DoD Defense Federal Acquisition Regulation Supplement (DFARS Subpart 46.7). Subpart 46.770, "Use of Warranties in Weapons System Procurements," specifically addresses the new warranty law and provides guidance and direction in such areas as tailoring, Government-furnished property, foreign military sales, warranty cost-benefit analysis, and waiver procedures.*

2.4.2 Requirements of Warranty Law

The following subsections summarize the requirements of 10 USC 2403 as well as applicable DoD guidance.

2.4.2.1 Coverage

Title 10, Section 2403, applies to all weapon system procurements starting after 1 January 1985. A weapon system is defined as "items that can be used directly by the Armed Forces to carry out combat missions and cost more than $100,000 or for which the eventual total procurement cost is more than $10,000,000." Although the date and dollar amounts are fairly clear, the combat mission orientation has caused considerable debate. The guidance provided by DoD in DFARS Subpart 46.770 interprets the weapon system definition quite broadly. Only support equipment (e.g., ground handling equipment), training devices, ammunition, and commercial items are specifically excluded. Table 2-2 summarizes some of the systems considered to fall within the scope of the law. The systems listed are provided for use in carrying out combat missions and commercial warranties, modified as [illegible] may be obtained for nondevelopmental [illegible] fall within the weapon system definition. Experience has shown that the military services are generally securing warranties for all items that exceed the minimum cost levels specified in the law, unless they fall under the specific coverage exclusions.

2.4.2.2 Warrantor

As stipulated in 10 USC 2403, the prime contractor must provide the warranty. For larger weapon systems for which there are subcontractors, the prime contractor may impose warranty requirements on the subcontractors; however, it is the prime that assumes responsibility in the event of a warranty breach.

In practice, there may be a relationship established between the Government and a subcontractor in conducting normal warranty activities. For example, to minimize turnaround time the Government may ship a failed unit directly to a subcontractor rather than through the prime contractor. Such a relationship should not alleviate the prime contractor from ultimate warranty responsibility; this should be made clear in the contract.

2.4.2.3 Warranties

The law requires that the following types of warranties or guarantees be provided:*

- Design and manufacturing requirements
- Defects in materials and workmanship
- Essential performance requirements

Each is discussed in the following subsections.

Warranty on Design and Manufacturing Requirements

Design and manufacturing requirements are the "structural and engineering plans and manufacturing particulars, including precise measurements, tolerances, materials and furnished product tests." This type of warranty provides assurance that the product is designed and built as specified. It covers such features as size, weight, interfaces, power requirements, and material composition. For many design and manufacturing requirements, a one-time verification may be all that is necessary; for example, it is not likely that the size or weight of an electronic unit will change without some specific design or manufacturing change. Periodic audits can be conducted during a production run to ensure continuity of adherence to the design and manufacturing requirements.

*Appendix C [illegible] Subpart 46.7, DFARS [illegible]

*The law [illegible] DFARS [illegible]

TABLE 2-1

SUMMARY OF 1985 WARRANTY LAW

Factor	Definition	Description
Coverage	Weapon systems	Used in combat missions; unit cost is greater than $100,000, or total procurement exceeds $10,000,000.
Warrantor	Prime contractor	Party that enters into direct agreement with U.S. to furnish part or all of weapon system.
Warranties	Design and manufacturing requirements	Item meets structural and engineering plans and manufacturing particulars.
	Defects in materials and workmanship	Item is free from such defects at the time it is delivered to the Government.
	Essential performance requirements	Operating capabilities or maintenance and reliability characteristics of item are necessary for fulfilling the military requirements.
Exclusions	GFP, GFE, GFM	Items provided to the contractor by the Government.
	Essential performance requirements for items not in mature full-scale production	The first 1/10 of the total production quantity or the initial production quantity, whichever is less.
Waivers	Necessary in the interest of national defense; warranty not cost-effective	Assistant Secretary of Defense or Assistant Secretary of the Military Department is lowest authority for granting waiver; prior notification to House and Senate committees required for major weapon system.
Remedies	Contractor corrects failure at no additional cost to U.S.; contractor pays for reasonable costs for U.S. to correct	Other remedies may be specified; contract price may be reduced.
Tailoring	Exclusions, limitations, and time duration	Specific details to be negotiated.
	Dual-source procurements	Relieve second source from guaranteeing essential performance requirements for initial product delivered.
	Extensions	Extend coverage and remedies as deemed beneficial.

TABLE 2-2

SYSTEMS CONSIDERED TO FALL WITHIN THE WEAPON SYSTEM DEFINITION

Tracked and wheeled combat vehicles
Self-propelled, towed, and fixed guns
Howitzers and mortars
Helicopters
Naval vessels
Bomber, fighter, reconnaissance, and EW aircraft
Strategic and tactical missiles, including launching systems
Guided munitions
Military surveillance, command, control, and communications systems
Military cargo vehicles and aircraft
Mines
Torpedos
Fire control systems
Propulsion systems
Electronic warfare systems
Safety and survival systems

Warranty Against Defects in Materials and Workmanship

As stated in 10 USC 2403, "the item provided under the contract, at the time it is delivered to the United States, will be free from all defects in materials and workmanship." DFARS Subpart 46.7 uses the term "weapon system" instead of "item" and replaces the reference to time of delivery with "at the time of acceptance or delivery." It is clear that this clause is directed at controlling latent defects (see Section 2.2.2). Usually a discovery period is specified that often is the same as the warranty duration applicable to the control on essential performance requirements. It has been recommended that, if the defects-in-materials clause is to be used to protect against all defects, latent or otherwise, the reference to the condition at time of delivery or acceptance should be removed. This suggested change is consistent with the law and guidance to broaden the coverage when deemed beneficial.

Warranty of Conformance to Essential Performance Requirements

Essential performance requirements are defined in 10 USC 2403 as "the operating capabilities or maintenance and reliability characteristics of the system that are determined by the Secretary of Defense to be necessary for the system to fulfill the military requirement for which the system was designed." This clause represents a major departure from usual procurement practice, in that it extends the contractor's liability for satisfactory product to operational performance, including reliability and maintainability. The "old way" requirement to pass a reliability acceptance test may be replaced by the "new way" warranty of measuring field reliability over a period of time and comparing such measurement to a guaranteed value. Failure to meet a stated performance requirement could be cause for the contractor to be liable for redesign of the product. Clearly, such a potential liability imposes a challenge to the warranty developers to ensure that the terms and conditions are fair and equitable and that the warranty can be implemented and administered effectively.

For many of the warranties contracted soon after the law became effective, the issue of defining the essential performance requirements to be guaranteed was sidestepped by including all the requirements contained in applicable specifications. Such an approach can lead to problems, since some requirements are not meant to apply under operational considerations

(e.g., MTBF values to be tested by MIL-STD-781 procedures), and others may not be easily measured in the field without special instrumentation or controlled testing (e.g., missile accuracy). As an example of selective use of guaranteed requirements, the warranty on the Air Force alternate fighter engine includes controls on engine removal rate, specific fuel consumption, and engine thrust—with all such controls extending for up to eight years after engine acceptance.

Guarantee of essential performance requirements applies only to units in mature full-scale production—that is, units manufactured after the first one-tenth of the total production or after the initial production quantity, whichever is less.

2.4.2.4 Exclusions

A warranty exclusion is a condition or event for which there is no warranty coverage. DoD guidance specifically excludes Government-furnished items, except possibly for their installation. The essential performance requirement coverage for the first one-tenth of the total production quantity, or the initial production quantity, whichever is less, may also be excluded as stipulated in the law. Other exclusions, such as failures resulting from mishandling or mistreatment, may be added as appropriate.

2.4.2.5 Waivers

The warranty law allows for a waiver of part or all of the coverage requirements of the statute (subsection (b)) if it is determined (1) that the waiver is necessary in the interest of national defense, or (2) that a guarantee under that subsection would not be cost-effective. The waiver authority is no lower than the Assistant Secretary of Defense or Assistant Secretary of the Military Department. The DoD may issue class waivers when justified.

If a waiver is granted, notification or reports to the Senate and House Committees on Armed Services and Appropriations must be made as follows:

- *Major weapon systems*—Thirty days prior to granting a waiver, the committees shall be notified in writing of the intent to waive and reasons for the waiver. If a major weapon system not yet in mature full-scale production does not include an essential performance requirement, then notice of such exemption shall be given.
- *Other weapon systems*—An annual report shall be submitted by 1 February of each year, listing all waivers granted and the reasons for waiver.

To date, there has been very limited use of waivers. Research of warranties that have been written and discussions with a number of military program, contractor, and staff personnel revealed that the services have adopted a general policy of structuring warranties to overcome any possible implementation or cost problems rather than seeking the waiver route. Since there is only limited experience in fielding systems with warranties written under 10 USC 2403, it is too early to judge whether this policy will have to be modified.

2.4.2.6 Remedies

If an item fails to meet any of the warranties stipulated in the contract, then, under 10 USC 2403, the contractor is required to:

> (A) promptly take such corrective action as may be necessary to correct the failure at no additional costs to the United States; or
>
> (B) pay costs reasonably incurred by the United States in taking such corrective action.

DFARS Subpart 46.7 offers an alternative, essentially a form of the second requirement, that allows the contracting officer to reduce the contract price equitably.

Some warranties have been written that more or less duplicate the wording of the law, while others go into great detail to spell out the remedies. While simplicity is a laudable objective, there generally should be more detail than a restatement of the legal requirement. For example, what does "promptly" mean with regard to correcting a problem? What if a unit is returned for which the contractor can find no problem? If the problem is due to a faulty part design, does replacing the failed part with an identical one destined to soon fail again constitute a valid correction?

Another important issue with regard to warranty breach and remedy is the means for determining if a warranty breach has occurred. The Government expects to receive warranty services when a breach occurs, but it should not have the unlimited right to send units back for warranty service without some verification of occurrence of a breach. In the same sense, the contractor should not be able to claim, without adequate support, that a breach has not occurred, because of either a "test OK" result or applicability of a warranty exclusion. These issues are treated more fully in Chapter Six.

2.4.2.7 Tailoring of Warranties

The wording of 10 USC 2403 and the ensuing DFARS Subpart 46.7 suggests that tailoring of the warranty terms and conditions to match the system, procurement, and operational conditions is necessary to develop a cost-effective approach. 10 USC 2403 suggests that specific details regarding reasonable exclusions, limitations, and time duration be negotiated. Guarantees that provide more comprehensive remedies than those provided in the statute are also to be considered. In DFARS Subpart 46.7, such factors as technical risk, contractor financial risk, and program uncertainties are listed as potential reasons for limiting the contractor's liability under the terms of the warranty. An example is given of narrowing the scope of the essential performance requirement because a contractor had not designed the system. It is also stated that it is not Department of Defense policy to include contractor liability for loss, damage, or injury to third parties.

2.4.3 Cost-Benefit Analysis

The cost-effectiveness of a potential warranty is a major determinant of whether a waiver should be requested. DFARS Subpart 46.7 requires that a warranty cost-benefit analysis be conducted and documented in the contract file. The DFARS requires comparing the benefits of a warranty with its acquisition and administrative costs. Where possible, a comparison should also be made with the costs of obtaining and enforcing similar warranties on similar systems. It is also suggested that a life-cycle-cost (LCC) basis be used, comparing LCC with and without a warranty. Such an approach has been used in the past on programs that have considered using the more extensive forms of warranty such as RIW and MTBF guarantees.

2.4.4 Other Warranty Policy Issues

DFARS Subpart 46.7 also offers guidance in the following areas:

- *Government-furnished property (GFP)*—Warranties provided by the prime contractor on GFP shall not generally be required, except for defects in installation, installation or modification that invalidates a warranty provided by the manufacturer of the property, or modifications made to the property by the prime contractor.
- *Alternate sources or suppliers*—Alternate source contractor(s) may be excused from the essential performance requirement of the first article until that contractor manufactures the first one-tenth of the total anticipated production quantity.
- *Foreign military sales (FMS)*—Warranties are not mandatory for FMS production contracts. However, it is DoD policy to obtain the same warranties for FMS purchasers as obtained by the United States for defects in materials and workmanship, and conformance to design and manufacturing requirements. Normally, essential performance warranties will not be obtained for FMS purchasers. Warranty costs for FMS purchasers may be higher than for the United States, and the FMS purchasers must bear all of the warranty acquisition and administration costs.
- *Commercial supplies*—The DFARS references FAR 46.709 regarding warranties of commercial supplies. Generally, the Government may adopt the contractor's standard commercial warranty if it is not inconsistent with the rights that would be afforded the Government under a warranty-of-supplies clause or other contract terms. If the Government's specifications have altered the item, or if the planned usage of the item differs from normal usage, the warranty language should be altered appropriately. Forms of commercial warranty have been used by the military on such items as vehicles, guns, and commercial avionics.

2.5 MILITARY WARRANTY POLICY AND FOCAL POINTS

2.5.1 U.S. Army

It is evident from the policy statements and from interviews conducted with Army personnel that the single most important aspect of the warranty acquisition process is to tailor the warranty so that it has minimal impact on standard Army logistical procedures. As one official stated, "warranty should be invisible to Army field maintenance personnel." Army warranty policy is provided in Army Regulation (AR) 700-139, Army Warranty Program Concepts and Policies, effective 10 April 1986. This regulation, although focused on 10 USC 2403, also applies to non-statute warranties. The Army regulation establishes responsibilities, definitions and procedures, and standards for [illegible] fielding, [illegible] warranties. Additional guidance is contained in Army Materiel Command Supplement 1 to AR 702-3.

AR [illegible] a w[illegible]

various interested activities, and to provide an electronic mailbox for information flow and a 24-hour hotline for resolution of warranty problems. Major commands are also directed to establish a warranty control office or officer (WARCO) at the MACOM level to ensure effective execution of warranties.

With respect to warranty concepts, reliability improvement warranties are specifically exempted from coverage in the regulation, since such an approach is considered to be a reliability improvement incentive. The Army considers reliability improvement warranties to be useful in unique instances where reliability is known to be deficient and reliability growth is possible. Since another regulation (AR 702-3) had previously been prepared for the reliability improvement concept, the Army chose not to include that concept in AR 700-139.

Policy guidance that has been issued reflects the Army's belief that one of the most effective remedies available to achieve the required performance requirements is the redesign of potentially defective parts. Acquisition managers have been directed not to exclude a redesign remedy from warranty coverage as had been done on several major programs.

Warranty coverage for centrally procured equipment should generally include both coverage for failures of individual items and coverage for system defects; the latter may involve a potential redesign liability. If claim processing costs are expected to exceed estimated claim recovery costs, only systemic coverage should be used. The duration of a warranty should be between 10 and 25 percent of the expected life and generally not less than one calendar year of operation.

Procedures and forms for warranty identification, data collection, and claims have been standardized throughout the Army. A central data collection activity has been operating since August 1984, gathering information on acquired warranties and publishing an index of equipment under warranty, a list of warranty control offices, and periodic Army-wide newsletters to share warranty events and information.

Table 2-3 lists the offices designated as U.S. Army warranty focal points. These offices are responsible for warranty management within each commodity command. The field commands responsible for execution of Army warranties also have designated warranty control offices as listed

2.5.2 U.S. Navy

Navy warranty policy is being developed in proposed Secretary of the Navy Instruction (SECNAVINST) 4330.xx, Navy Policy on Warranties. The instruction will focus on 10 USC 2403, FAR Subpart 46.7, DFARS Subpart 46.7, and SECNAVINST 7000.14B to ensure that the Navy obtains and administers cost-effective warranties and uses them to enhance the reliability of systems, subsystems, and materials.

Navy activities will take action to implement the provisions of the instruction. It is expected that the provisions will include the following:

- Policy on warranty requirements, cost-benefit analysis, acquisition planning, identification marking, failure reporting, period of coverage, participation with the Air Force Product Performance Agreement Center, and supply policies
- Development of procedures for implementing warranty terms and conditions, establishment of warranty administration points of contact, and integration of appropriate supply and maintenance regulations
- A reporting system to ensure proper warranty administration

Table 2-4 lists offices that have been designated as U.S. Navy warranty focal points.

2.5.3 U.S. Air Force

With reference to 10 USC 2403, Air Force policy documents indicate that the Air Force will require a warranty plan for each procurement, documenting the responsibilities, decisions, taskings, and strategies for warranties. Specific planning areas are as follows:

- Brief statement of the need and summary of the technical and warranty history
- Membership of the acquisition team
- Responsible action point, contracting officer, warranty manager, and other points of contact deemed necessary for warranty administration
- Organizational responsibilities for warranty management
- Duration, marking, measurement basis, reporting, disposition, material accountability, and other information pertaining to the administration of the warranty
- Cost benefit analyses documentation
- Essential performance characteristics that are warranted

TABLE 2-3

ARMY WARRANTY FOCAL POINTS

Office	Address	Telephone Number
Army Materiel Command		
Policy/Executive Agent for Warranty	AMCQA-W Headquarters, AMC Alexandria, VA 22333-50001	AV 284-4018 (202) 274-4018
Armament, Munitions, and Chemical Command	AMSMC-QAD, AMCCOM Rock Island, IL 61299-6000	AV 793-2421 (307) 782-2421
Aviation Systems Command	AMSAV-QR, AVSCOM St. Louis, MO 63120-1798	AV 693-1771 (314) 263-1771
Communications and Electronics Command	AMSEL-PA-W, CECOM Ft. Monmouth, NJ 07703-5000	AV 992-2220 (201) 532-2220
Depot Systems Command	AMSDS-QS, DESCOM Chambersburg, PA 17201-4120	AV 238-7946 (717) 263-7946
Laboratory Command	AMSLC-PR Adelphi, MD 20783-1145	AV 290-3690 (301) 394-3690
Missile Command	AMSMI-QA-WA Redstone Arsenal, AL 35898-5000	AV 746-5115 (205) 876-5115
Tank Automotive Command	AMSTA-MW Warren, MI 48397-5000	AV 786-7889 (313) 574-7889
Troop Support Command	AMSTR-QE St. Louis, MO 63120-1798	AV 693-2879 (314) 263-2879
Materiel Readiness Support Activity	AMXMD-MS Lexington, KY 40511-5001	AV 745-3690 (606) 293-3690
Field Commands		
Training and Doctrine Command	ATPL-MM Ft. Monroe, VA 23651	AV 680-3248 (804) 727-3248
Forces Command	AFLG-SMM Ft. McPherson, GA 30330	AV 588-3820 (404) 752-3820
Western Command	APZV-DIO Ft. Shafter, HI 96858	AV 438-1410
Eighth U.S. Army	DJ-MS-MM Soeul, Korea	AV 262-1101
U.S. Army Europe 200th TAMMC	AEAGD-MMC-RL-W Zweibrucken, West Germany	494-2281-6568/8268

TABLE 2-4

NAVY WARRANTY FOCAL POINTS

Office	Address	Telephone Number
Office of the Assistant Secretary of the Navy (S&L), Contracts and Business Management	CBMMA Washington, D.C. 20[illegible]	(202) 692-8658
Commander Naval Sea Systems Command	SEA 901 Washington, D.C. 20362-5101	(202) 692-6731
Commander Space and Naval Warfare Systems Command	SPAWAR 2011 Washington, D.C. 20363-5100	(202) 692-6046
Commander Naval Air Systems Command	AIR 5162 Washington, D.C. 20361-5160	(202) 692-7788
Commander Naval Supply Systems Command	SUP PML 550 Washington, D.C. 20376-5000	(202) 692-5305
Commander Naval Facilities Engineering Command	FAC 021A 200 Stovall Street Alexandria, VA 22332-2300	(202) 325-9121

- FMS coverage and related administrative requirements
- Applicability under the law
- Procedures for tracking and accumulating warranty costs

The Air Force Logistics Command has also provided interim guidance on warranty administration (Reference 10). This guidance reflects a position taken by the other services; namely, that warranties should generally be structured to be consistent with current Air Force procedures. Specifically, the following constraints are included:

- The lowest level of hardware subject to warranty requiring contractor corrective action should be that which can be effectively marked using MIL-STD-130 procedures.
- To the extent possible, warranty duration should be stated as a fixed calendar date and be no longer than that required to identify defects.
- Parameters selected for warranty coverage must be measurable, and the method of measurement must be included in the warranty clause.
- Failure analyses and associated reports should be required for all items returned for correction to provide contractor feedback.
- Generic clauses, tailored to meet specific requirements, should be used to the extent possible, with [illegible] activity developing such clauses in coordination with warranty administrative offices.

Initial plans [illegible] formulated to establish an interim [illegible] and an automated process [illegible] administer warranties.

[illegible] have been designated as U.S. Air [illegible] focal points.

[illegible] most extensive experience with [illegible], particularly RIW,

TABLE 2-5

AIR FORCE WARRANTY FOCAL POINTS

Office	Address	Telephone Number
Warranty Contracting	HQ USAF/RDCS Pentagon Washington, D.C. 20330	(202) 697-6400
Warranty Administration	HQ USAF/LEYE Pentagon Washington, D.C. 20330	(202) 697-0311
Air Force Systems Command	HQ AFSC/PLE Andrews AFB, MD 20334	(301) 981-4076
Air Force Logistics Command	HQ AFLC/MMA Wright-Patterson AFB, OH 45433	(513) 257-7119
Warranty Data Base and Consulting	Product Performance Agreement Center Wright-Patterson AFB, OH 45433	(513) 255-5459

MTBF guarantees, and logistic support cost guarantees. To provide a central resource for warranty/guarantee development, the Air Force established the Product Performance Agreement Center, which is discussed in Section 2.6. Reference 6, the Product Performance Agreement Guide (Reference 7) reflects the current Air Force position on warranty/guarantee during the acquisition process.

2.6 PRODUCT PERFORMANCE AGREEMENT CENTER (PPAC)*

The Air Force PPAC was established to assist Air Force activities involved in the acquisition of defense systems and their support in selecting, structuring, pricing, negotiating, and implementing effective PPAs and related logistics arrangements. To promote the use of PPAs in Air Force procurements pursuant to DoD Directive 5000.1, to promote effective application and [illegible] of PPAs at all levels, the PPAC currently performs the following functions:

- Serves as the central repository of Air Force PPA-related data
- Analyzes the effectiveness of existing and proposed warranties, guarantees, award fees, incentives, related contractual provisions, solicitation instructions, and other PPA associated contracting strategies and management and administration systems
- Develops improved contract clauses and related concepts as well as methodologies for selecting appropriate and cost-effective PPAs
- Provides technical assistance to Air Force activities in selecting, tailoring, pricing, negotiating, and administering appropriate agreements through direct consultation with program and system managers and staff; periodic publication of guides, handbooks, and technical reports; and periodic sponsorship of workshops, symposia, briefings, and other communications designed to improve Air Force-wide use of PPAs
- Formulates proposed policy guidance for HQ USAF consideration concerning application of PPAs to Air Force acquisitions

*The term "product performance agreement" [illegible] the Air Force to mean [illegible] relating to the performance [illegible]

Chapter Three
WARRANTY CONCEPTS AND ISSUES

3.1 DEFINITIONS

To provide a basis for discussion of various warranty concepts and issues, the following definitions are presented:

- *Acceptance*—The act of an authorized representative of the Government by which the Government, for itself or an agent of another, assumes ownership of existing identified supplies tendered or approves specific services rendered as partial or complete performance of the contract.
- *Correction*—Elimination of a defect.
- *Defect*—Any condition or characteristic in any supplies or services furnished by the contractor under the contract that is not in compliance with the requirements of the contract.
- *Design and manufacturing requirements*—Structural and engineering plans and manufacturing particulars, including precise measurements, tolerances, materials, and finished product tests for the weapon system being produced.
- *Essential performance requirements*—Operating capabilities and reliability and maintenance characteristics of a weapon system that are determined by the Secretary of Defense (or delegated authority) to be necessary for the system to fulfill the military requirement for which it is designed.
- *Initial production quantity*—The number of units of a weapon system contracted for in the first program year of full-scale production.
- *Inspection*—Examination and testing of supplies or services (including, when appropriate, raw materials, components, and intermediate assemblies) to determine whether they conform to contract requirements.
- *Mature full-scale production*—Follow-on production of a weapon system after manufacture of the lesser of the initial production quantity or one-tenth of the eventual total production quantity.
- *Prime contractor*—Party that enters into an agreement directly with the United States to furnish a system or a major subsystem.
- *Warranty*—A promise or affirmation given by a contractor to the Government regarding the nature, usefulness, or condition of the supplies or performance of services furnished under the contract.
- *Warranty breach*—A failure to meet the warranty terms and conditions.
- *Warranty remedy*—Actions of a contractor to meet its obligations under the terms of the warranty when a warranty defect occurs.
- *Weapon system*—System or major subsystem used directly by the armed forces to carry out combat missions.

3.2 WARRANTY CLASSIFICATIONS

A number of warranty classification schemes have been developed to describe alternatives available to procurement activities. The classification scheme used in this handbook distinguishes between assurance and incentive forms of warranty. The Product Performance Agreement Guide provides several types of incentive warranties.

3.2.1 Assurance and Incentive Warranties

The term "assurance warranty" is used when the primary intent is to assure that minimum design, quality, and performance levels are achieved. The Government is not seeking anything more than the contract specifies, and the warranty concept and terms and conditions do not provide any incentives for the contractor to do otherwise. This is the type of warranty required by 10 USC 2403.

The term "incentive warranty" is used for the type of warranty that provides incentives for the contractor to exceed minimum design, quality, or performance levels. For such a warranty, the contractor can adapt a strategy to just meet the minimum performance levels. However, the warranty is structured so that the risks of failing to achieve the minimum levels, or the potential profit associated with exceeding those levels, will normally motivate the contractor to try to exceed minimum levels. This type of warranty may or may not meet the requirements of 10 USC 2403.

The distinction between the two basic forms can be illustrated by an example. Let us assume that an equipment is to be procured that has a field MTBF requirement of 1,000 hours. For the selected warranty period, the warranted items are expected to operate for a total of 200,000* hours. Therefore, if the MTBF requirement is met, the total number of failures expected to occur is 200,000/1,000 = 200.

For an assurance type of warranty, the terms and conditions may state that all failures beyond 200 that occur during the warranty period must be repaired by the contractor at no additional cost to the Government. The contractor does not benefit from producing equipment with better than a 1,000-hour MTBF.

Now let us consider an incentive warranty form for the same example. Suppose the contractor is to provide [illegible] services for this equipment over the warranty period for a fixed price, which is based on the required MTBF of 1,000 hours or 200 expected failures. The contractor, aware of this pending warranty [illegible] realizes that each failure that can be eliminated results in more profit. The contractor therefore has the incentive to invest in design, production, and [illegible] assurance to reduce the number of future failures. In addition, there is an incentive to search for the existence of pattern failures, and, if a "pattern" type failure is observed early in the deployment phase, to develop a fix to reduce or eliminate [illegible] failures. This type of warranty is known as a reliability improvement warranty (RIW) because of its [illegible] features.

Figure 3-1 [illegible] the relationship of the contractor's profit [illegible] Planned MTBF for this example. For both [illegible] warranties, the contractor will suffer a [illegible] MTBF less than 1,000 - X, where X represents the decrease in MTBF from 1,000 hours "covered" by the warranty profit/risk dollars in the contract price. For the assurance warranty, the contractor's profit rises to the expected contract profit and remains there for MTBF equal to or greater than 1,000. For the incentive form of warranty, the profit continues to rise with increasing MTBF and, theoretically, is asymptotic to a value near the contract warranty price – the only costs incurred being for warranty administration and warranty data as MTBF approaches infinity.

The distinction between assurance and incentive types of warranties is not always clear. Table 3-1 lists various procurement and deployment factors and their relationship to these two warranty types.

*[illegible] same for both [illegible] General [illegible] longer [illegible]

3.2.2 Assurance Warranty Issues

Assurance forms of warranty have been used in military production contracts for a number of years. Following the legislation of 10 USC 2403, there have been basically only two key changes in warranty practices:

- Application of warranties to weapon systems is mandatory rather than discretionary, as in the past.
- Of the three types of warranty coverage required under 10 USC 2403 (listed in Table 2-1), only the warranty for conformance to "essential performance requirements" reflects a new, post-acceptance commitment. (Warranty coverage for conformance to design and manufacturing requirements is traditionally covered under some form of the inspection clause; the warranty for freedom from defects is usually covered under the inspection clause or correction of defects on warranty of supplies.)

The developer of a warranty must be concerned with how best to define and include essential performance requirements and defect controls in a warranty, as well as the form that the warranty will take.

3.2.2.1 Essential Performance Requirements

The defense industry community recognizes that there could be several hundred performance requirements in a weapon system (in some cases masked as objectives, goals, and thresholds, including the specifications). Compliance with the majority of stated performance characteristics is determined through an evaluation of the information furnished to support the allocated ("design to") baseline of the

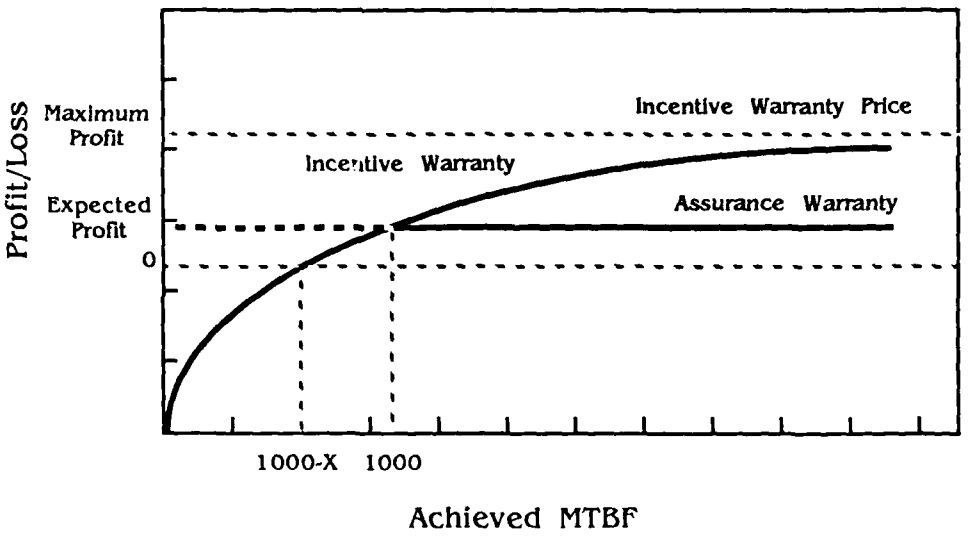

FIGURE 3-1
CONTRACTOR PROFIT–ASSURANCE VERSUS INCENTIVE WARRANTY

system during design and development. That is, the Government implicitly accepts the risk that the contractor's design will achieve specified performance requirements through a review of development specifications and drawings, qualification test results, and proposed acceptance procedures.

Since a warranty on essential performance requirements survives acceptance of the product, the Government, in conjunction with the contractor, must clearly identify those selected performance characteristics which survive the normal acceptance process. Instead of several hundred or so performance characteristics within a weapon system contract, there should be relatively few areas (perhaps three to five at most) in which the Government can clearly describe the compliance and evaluation method in the operational environment and satisfactorily negotiate any joint evaluation responsibilities with the contractor.

3.2.2.2 Defects in Materials and Workmanship Versus MTBF Requirements

There is a potential conflict between a control on all defects in materials and workmanship and an essential performance requirement on MTBF. Suppose the stated MTBF requirement "allows" up to F failures to occur for H hours of operation during the warranty period. The question of concern is whether the defects in materials and workmanship control applies to the first F failures. If the defects control is limited to those defects that existed "at time of delivery," then it is fairly clear that the two controls are not in conflict. The defects clause protects against initial quality problems, while the MTBF control is a reliability control for accepted product. The difficulty in this case is "proving" that the failure was a result of a defect existing at time of delivery.

If the time-of-delivery condition is removed, the conflict with an MTBF requirement may surface. This issue should be directly addressed to avoid further problems in implementing the warranty.

3.2.2.3 Assurance Warranty Forms

Assurance warranty forms have been as simple as a one-paragraph statement and as complex as a set of terms and conditions extending over a number of pages. Because of the relative newness of 10 USC 2403, a set of "generic" warranty forms has not yet been developed.

A warranty that defines a breach only when the number of failures exceeds a stated threshold is a form of assurance warranty. The Army expected-failure concept is an example of this approach. This concept may be applied to other performance

TABLE 3-1

COMPARISON OF ASSURANCE AND INCENTIVE TYPES OF WARRANTIES

Factor	Assurance Warranty	Incentive Warranty
Basic Intent	Meet minimum performance and R&M levels.	Exceed minimum levels.
Warranty Price	Expected to be minimal, from 0 up to 1 or 2 percent per year of hardware price.	May be significant, up to 7 or 8 percent per year of hardware price.
Warranty Duration	Limited -- generally 1 year or less.	Can be extensive -- 3 or more years.
Technology Factors	Warranted item is well within state of the art (SOA), or SOA is so severely "pushed" that only limited warranty protection is realistic.	Warranted item pushes SOA, so there is need to protect against failure and there is opportunity for growth.
Contractor	Contractor has limited opportunity to control and improve performance prior to and during warranty.	Contractor has significant opportunity to control and improve performance.
Competition	Should not reduce future competitive climate.	May significantly reduce competitive climate.
Administration	Generally not a severe burden.	May require complex procedures.

parameters, such as speed, range, power, and accuracy. The product must meet stipulated performance levels, and the warranty does not have a stated or implied incentive to exceed those stated levels.

There is a form of warranty that may have both assurance and incentive features. Consider a warranty that identifies several performance requirements for warranty coverage but has no incentive to exceed minimum levels. There is no direct reliability-related measure. As required by law, the warranty also covers defects in materials and workmanship. The warranty may be worded in such a way that all failures that occur during the warranty period are covered—irrespective of whether the failure exists at time of delivery, and irrespective of whether the population reliability level exceeds a specified value. For this case, the performance requirements represent an assurance form of warranty, but the defects clause has an inherent incentive in that the contractor's liability is reduced for each failure eliminated. The "strength" of the incentive depends on a number of complex factors, such as the length of the warranty, the contractor's ability to control certain types of defects, and the flexibility and capability to identify problems and institute corrective action.

3.2.3 Product Performance Agreement Guide Warranties

In 1980, the Air Force published the Product Performance Agreement Guide, which was developed by a joint Air Force and industry committee. The focus of the committee's efforts was to explore ways of enhancing contractors' participation in the field performance of their products through the concept of product performance agreements (PPAs). The document listed 23 types of product performance agreements. In November 1985, a revised Guide was issued (Reference 7), listing 28 forms of PPAs and providing additional background and guidance on their potential application. For each PPA, the Guide presents the following information, typically on one page:

- Objective
- Characteristic
- Applicability
- Description
- Measurement
- Result
- Advantages
- Disadvantages

Table 3-2 lists the 28 PPAs. As can be seen, there are a number of different alternatives, some of which are combinations of others (e.g., RIW with MTBF verification test).

TABLE 3-2

PRODUCT PERFORMANCE AGREEMENT FORMS

PPA Number	Title
I	Warranty of Supplies; Warranty of Systems and Equipment Under Performance Specifications or Design Criteria
II	Warranty of Technical Data
III	Warranty of Technical Orders
IV	Reliability Warranty
V	Maintainability Guarantee
VI	Reliability and Maintainability Warranty
VII	Reliability Improvement Warranty (RIW)
VIII	Reliability and Maintainability Improvement Warranty (R&MIW)
IX	Mean Time Between Failures Verification Test (MTBF-VT)
X	RIW with MTBF Verification Test
XI	R&MIW with MTBF/VT
XII	Component Reliability Warranty
XIII	Chronic LRU Guarantee
XIV	Availability Guarantee
XV	Logistics Support Cost Guarantee
XVI	Maximum Parts Cost Guarantee
XVII	Spare Parts Level Warranty
XVIII	Utility Functions Guarantee
XIX	Ultimate Life Warranty
XX	Commercial Service Life Warranty
XXI	Software Design Commitment Guarantee
XXII	LRU Software Configuration Control and Support Agreement
XXIII	Fault Detection, Isolation, and Repair Warranty
XXIV	Test and Repair Improvement Guarantee
XXV	Method of Test Guarantee
XXVI	Quality of Training Warranty
XXVII	Rewarranty of Repaired/Overhauled Equipment
XXVIII	Repair/Exchange Agreements

Four of the PPA forms listed in the Guide represent the more commonly used incentive forms of warranty:

- Reliability improvement warranty (RIW)
- Mean time between failures guarantee (MTBFG) (included as part of several PPA forms)
- Availability guarantee (AG)
- Logistics support cost guarantee (LSCG)

Table 3-3 summarizes these four forms. They are discussed in detail in the following subsections.

3.2.3.1 Reliability Improvement Warranty

The RIW form of warranty has been used most extensively in the past, particularly for electronic units. The objective of RIW is to achieve acceptable reliability while providing the motivation and mechanism for reliability improvement. This is accomplished through a fixed-price contract provision for the contractor to perform depot repair for all covered failures during the warranty period. Presumably, the price paid for the warranty is based on reasonable costs to repair covered failures when the field failure rate is consistent with that specified or "expected." If the warranty is for 200,000 operational hours and the Government expects a field MTBF of 1,000 hours, and if the contractor has provided equipment that meets this expectation, the number of failures expected to occur is 200,000/1,000 = 200. That number becomes the basis for negotiating a warranty price.

Clearly, it is in the interest of the contractor to produce an equipment with an MTBF greater than 1,000 hours if the incremental development or production costs to do so are less than the reduction in future warranty repair costs. The contractor, who is also performing the repair for all failures, has the opportunity to devote resources to detect pattern failures as early as possible. If a fix can be developed and implemented in time to reduce the number of future failures economically, the contractor will be motivated to do so (Reference 11). The terms and conditions of an RIW generally include exclusions,

TABLE 3-3

SUMMARY OF FOUR INCENTIVE FORMS OF WARRANTY

Incentive Warranty Form	Objective	Approach	Remedies	Application
Reliability Improvement Warranty (RIW)	Achieve acceptable reliability and motivate contractor to improve.	Contractor performs depot maintenance for at least two years under a fixed price.	Contractor repairs all covered failures and has the option of implementing no-cost ECPs for R&M improvement.	Units must be depot-repairable. Reduced military self-sufficiency must be tolerable.
Mean Time Between Failures Guarantee (MTBFG)	Provide assurance that required field MTBF level will be achieved.	Contractor guarantees field MTBF. Measurements are made and compared with guaranteed value.	Contractor must develop and implement solution if guarantee value is not achieved. Contractor may have to provide consignment spares in the interim.	MTBF is appropriate reliability parameter, and field measurement can be made.
Availability Guarantee (AG)	Provide assurance that required operational availability will be achieved.	System availability is measured in the field or through special test and compared to guaranteed values.	Same as for MTBF guarantee.	Availability is appropriate readiness parameter, and acceptable measurement methods can be implemented.
Logistics Support Cost Guarantee (LSCG)	Control logistics support costs.	Contractor "bids" target logistics support cost through use of a model. Field parameters are measured, and the same model is used for obtaining measured logistics support costs and compared to target.	Contract price is adjusted based on measured versus target values; a correction of deficiency may be required.	Appropriate LSC model exists. Generally requires a special test program to obtain measured values.

failure-verification procedures, turnaround time controls, operate time adjustments, data requirements, and storage and transportation procedures.

RIW has been used successfully on such programs as the Navy F-14 hydraulic pump, Air Force ARN-118 TACAN and F-16 avionics, and Army ARN-123 CONUSNAV radio. Although the RIW approach has required some changes to support systems, it has proved to be administratively workable, and it is considered to be one of the more important and useful forms of incentive warranty.

3.2.3.2 Mean Time Between Failures Guarantee

MTBFG provides a direct means for controlling the operational reliability of fielded equipment. This is accomplished by specifying in the contract the MTBF to be achieved in the field, a means for measuring the operational MTBF, and actions to be taken if the measured MTBF is less than the guaranteed value.

MTBFG Values

Two approaches to determining MTBFG values have been used: specifying the MTBFG value in the RFP, and having contractors bid an MTBFG value. If contractors are to bid values, the RFP should generally specify a minimum value—one that is consistent with the system specification and development program. The bid value and the MTBFG price are potential source-selection factors.

A consideration regarding specified MTBF values is to allow for reliability growth. This is generally accomplished by designating an initial period over which no MTBF guarantee is in force. Such a period will allow for stabilization of problems associated with initial installation and operation and for correction of initial production problems. A schedule of guaranteed values may be used to then "grow" the MTBF up to the final desired value. Thus, for the first six months of operation, there may not be any guarantee; for the second six months, the guaranteed MTBF may be equal to X; and for the next 12 months, the guaranteed value may be X+Y, where Y is a positive number.

MTBF Measurement

The contract must specify how MTBF is to be measured. If a current military data system can support such a measurement requirement, that data system may be used. In many cases current data systems may not be adequate, and a special measurement process will have to be instituted.

Generally, MTBF is defined as operating exposure divided by the number of relevant failures. Ideally, operating exposure is the number of operating hours or cycles of the warranted item. In practice, this may be difficult to obtain, and pseudo-measures such as platform hours (e.g., aircraft hours) may be used. In some cases, a statistical sampling procedure using elapsed-time-indicator readings has been used to calculate operating exposure (Reference 12).

MTBFG Remedies

In the event a measured MTBF value fails to meet the guaranteed value, the contractor is to supply the following typical remedies:

- Engineering analyses to determine the cause of MTBF nonconformance
- Corrective engineering design or production changes
- Modifications of units as required
- Pipeline consignment (loaner) spares in accordance with a contractually specified method to support the logistics pipeline pending improvement in MTBF

Past applications of MTBF guarantees have used a formula for determining the number of consignment spares that reflects the shortfall in pipeline spares as a result of an MTBF lower than expected. Typically, a maximum penalty is specified to limit the contractor's liability. If and when MTBF improves, the Government is required to either buy or return the loaners. It is also possible to include a positive incentive if the MTBF exceeds the guarantee value by a certain factor. To date, this approach has not generally been tried, because most MTBF guarantees have been used in conjunction with an RIW for which there already is an inherent positive profit incentive to exceed the guarantee value.

The MTBF guarantee is best applied when the unit is under contractor maintenance (such as for an RIW), so that problems can be quickly identified and remedies developed. The unit under the MTBF guarantee should be in production if a consignment spares provision is invoked; otherwise, this remedy may not be practical. The MTBF guarantee in conjunction with an RIW provides a good method for assuring satisfactory or improved reliability performance, as evidenced by the number of successful programs to which it has been applied (References 13 and 14).

3.2.3.3 Availability Guarantee

An availability guarantee is similar in concept to an MTBF guarantee, in that it focuses on a measurable population characteristic rather than on individual system failures. In this case, the characteristic is operational availability, which measures the system readiness state. Availability guarantee is most applicable for systems that are normally dormant or partially dormant, such as missile systems, but that have a high operational availability requirement. A form of an availability guarantee has been used for subsystems of the air-launched cruise missile. The availability guarantee may also be used for continuously operating systems such as a radar warning system.

In its most elementary form, availability can be defined as

$$A = \frac{MTBF}{MTBF + MDT}$$

where

MTBF = mean time between system failures

MDT = mean downtime (time to restore a failed system)

In this form, A can be interpreted to represent the proportion of time that the system is operational. Availability is influenced by two system characteristics: reliability and restoration capability. The latter characteristic is a function of maintainability and logistics factors.

In practice, an availability guarantee is implemented in a manner similar to an MTBF guarantee. Availability values are specified in the contract. Periodic measurements are made of fielded systems to obtain operational availability statistics. If the measured operational availability is less than the contractually guaranteed value, the warranty remedies are invoked—typically a requirement for the contractor to correct the deficiency and possibly to supply loaner spares in the interim.

Availability Guarantee Values

Availability is a multidimensional characteristic; an infinite number of combinations of MTBF and MDT values can result in a given A value. For some applications, only a subset of such combinations may be appropriate; this must be recognized in establishing the availability guarantee value. For example, one might specify an availability requirement of 0.95, provided that the system MTBF is at least 100 hours. It is also necessary to recognize that the downtime component of availability may involve elements that are not under contractor control, e.g., logistics administration time such as waiting for tools or test equipment. Normally, the guarantee value and corresponding measurement procedure should not penalize a contractor for negative factors for which the contractor is not at fault.

Availability Measurement

The availability measurement process can be somewhat complex and needs to be tailored to the specific application. For dormant systems, data from periodic check-outs, test launches, built-in test equipment (BITE) checks, and other sources such as special tests may be combined to yield a measured availability. For continuously operating systems, the ratio of up time to total time may be measured, a work sampling approach may be used, or individual measurements of MTBF and mean time to repair (MTTR) may be combined to provide availability statistics.

Availability Guarantee Remedies

Remedies for availability guarantee often take the same form as those used for MTBFG; namely, the cause of low availability has to be corrected, and consignment spares may be required in the interim.

3.2.3.4 Logistics Support Cost Guarantee

The logistics support cost guarantee is used when the main focus for control is logistics support cost (LSC). A target logistics support cost (TLSC) is established in the contract, reflecting the costs to support the guaranteed equipment. Appropriate statistics on fielded equipment are collected, usually through a special test, and measured logistics support cost (MLSC) is calculated. The MLSC is then compared with the TLSC; if the MLSC is greater, a warranty breach has occurred, and specified remedies must be implemented. For some programs, if the MLSC is less than the TLSC, a positive incentive such as an award fee may be applied.

LSGC has been used on such programs as the Air Force F-16 and the Navy F-18 (Reference 15). For the F-16, the LSCG approach was used on the complete aircraft (less GFP), except for "high burner" avionics for which an R1W or R1W MTBF was applied.

Target Logistics Support Cost

The TLSC is usually defined through use of a model that combines acquisition costs, reliability and maintainability (R&M), and support factors. Cost elements included in an LSCG are typically selected from the following cost categories:

- Hardware acquisition
- Initial spares
- Replenishment spares
- Organizational, intermediate, and depot maintenance
- Support equipment
- Support of support equipment
- Training
- Data
- Inventory management
- Other special factors

The request for proposals (RFP) will generally provide details on the model to be used to generate these costs. It will include a set of standard factors such as military labor rates and Government transportation times, and will specify the size of the population (the number of operational systems) and the number of life-cycle years to consider. Other factors, such as equipment costs and equipment MTBF and MTTR values, are proposed by the contractor and inserted into the model to yield the TLSC. Generally, the contractor does not guarantee the individual proposed values unless special provisions are included.

Logistics Support Cost Measurement

Computation of measured logistics support costs usually entails implementing a special data collection system to collect statistics on the values proposed by the contractor that were used to obtain the TLSC. These statistics, together with the same standard (default) values, are then inserted into the LSC model to yield the MLSC. For example, for the F-16 program, a six-month special data collection effort was conducted at one operational base to collect reliability, maintainability, and logistics statistics.

LSCG Remedies

A number of warranty remedies are available. One option is to use a contract price adjustment provision, in which the contract price is reduced by an amount proportional to the estimated support cost overrun. Another option is to invoke a correction-of-deficiencies clause, in which the contractor must identify the causes of the overrun and design and implement a fix. In some cases, a cost-sharing arrangement may be established. To provide positive incentives, there may be a provision that the contractor receives additional monies if the MLSC is less than the TLSC. This may be accomplished by a formula, or, more typically, through an award fee process.

3.2.3.5 Comparison of Warranty Forms

Table 3-4 summarizes the four incentive warranty forms considered with respect to a number of risk and implementation factors. The table also includes the assurance form of warranty as a point of departure. The comparisons are relative; the contractor pricing risk for an assurance warranty is low in relation to the RIW pricing risk, which is deemed moderate.

3.3 CONFORMANCE DETERMINATION

One rule that must be steadfastly maintained in developing an effective warranty is to ensure that means are available for determining whether an item conforms to the warranty. When the warranty coverage refers to an individual item, such as for a materials or workmanship defect, reference can be made to a specification and, if applicable, a particular test procedure. The test procedure, which may be the same as that used to perform final inspection before acceptance, is invoked if the contractor does not believe the warranty claim to be valid. A more difficult problem is usually faced when the warranty coverage refers to a population of items such as field MTBF or logistics support costs. In such cases, the warranty clause should clearly specify the measurement methodology (e.g., procedures, equations, data) to be used to verify that the item conforms to the warranty conditions.

3.4 WARRANTY REMEDIES

A warranty remedy is the action the contractor must take in the event the product does not meet the requirements stipulated in the warranty statement. Standard remedies are discussed in the following subsections.

3.4.1 Repair and Replacement

A defect may be corrected through a repair or replacement action. Typically, such a remedy would

TABLE 3-4

COMPARISON OF WARRANTY FORMS

Factor	Assurance Warranty	Reliability Improvement Warranty	Mean Time Between Failures Guarantee	Availability Guarantee	Logistics Support Cost Guarantee
User Risk of Not Achieving Objectives	Moderate to high	Moderate	Low to moderate	Moderate	Moderate
Contractor Pricing Risk	Low	Moderate	High	Moderate to high	Moderate to high
Administration Difficulty	Low	Moderate	High	High	Low to moderate
Enforceability Risk	Low to moderate	Moderate	Moderate	High	Moderate to high
Contractor Motivation for Improvement	Low	Moderate	High	Moderate	Low to moderate
Warranty Period	Short	Moderate to long	Moderate	Moderate	Short to moderate
Warranty Services Provided by Contractor	Repair or replace warranty failures; redesign if necessary	Depot maintenance, plus no-cost ECPs	Logistics assets if required, plus no-cost ECPs	Logistics assets if required, plus no-cost ECPs	Logistics assets if required, plus no-cost ECPs

be applied to an individual-item defect as opposed to a population defect. If the contractor performs the repair or supplies the replacement, there is no additional cost to the Government; if the Government performs the repair or supplies the replacement, it may bill the contractor. The term "bill back" is often used to describe this remedy form. The amount or the method by which the amount is determined is generally specified in the contract. Normally, the bill-back amount cannot exceed the contractor's normal repair and replacement costs.

3.4.2 Redesign

When the defect that exists pertains to the whole population, the warranty terms and conditions may require a redesign. Such action would normally be required when an essential performance requirement is not met. An example is the MTBF guarantee for which the contractor must determine the cause of low MTBF and design and implement a fix.

3.4.3 Price Adjustment

In some cases, correction of a defect may not be possible or practical, and the only remedy available may be to adjust the contract price downward. In this sense, the amount of the adjustment must be commensurate with damages suffered by the Government. An example of such adjustment is the logistics

support cost guarantee. If a "measured" logistics support cost is greater than the corresponding guaranteed value, the contractor may have to "pay" all or part of the difference through a downward adjustment in contract price. On the other hand, the contractor may share some or all of the potential savings if the measured support cost value is lower than that guaranteed.

3.4.4 Other Remedies

Combinations of the above remedies may be used, as well as other forms. For example, warranties that require contractor repair usually have a specified turnaround time requirement. The warranty period on a unit may be extended one day for each day the turnaround exceeds the specified value. The consignment spares provision of an MTBF guarantee is an example of another remedy form. Although such spares are to be used to maintain the pipeline temporarily, the warranty may stipulate that the consignment spares become Government property if the contractor cannot correct the low MTBF through redesign.

3.5 WARRANTY ACQUISITION ISSUES —CONTRACTOR MOTIVATION

To develop an effective warranty program, the program manager must look beyond the basic requirements of 10 USC 2403. Two ways of looking at a warranty program are as follows:

- Obligational viewpoint – Develop a warranty that will obligate the contractor if the product is not satisfactory, i.e., an assurance warranty.
- Motivational viewpoint – Develop a warranty that will motivate the contractor to provide quality product, i.e., an incentive warranty.

Both approaches can be effective. In many cases, contracting and administrative constraints will dictate the simpler assurance warranty form. However, if the resources are available to develop and implement a warranty program from a motivational viewpoint, the likelihood of meeting or exceeding minimum requirements is enhanced. Proceeding with a costly warranty program will require that the procuring agency first conduct a complete cost-benefit analysis to justify the greater investment costs generally associated with incentive warranties.

Section 3.5.1 addresses contractor reliability motivations. Section 3.5.2 discusses other motivations associated with a warranty commitment.

3.5.1 Contractor Reliability Motivations

Reliability is one of the principal system performance parameters that the warranty law addresses. Reliability differs from quality in the sense that it pertains to the long-term performance of the system – the probability that the system will perform satisfactorily throughout the mission – or, the mean time between system failures.

Contractors generally have a positive attitude toward quality. Quality inspections are normally performed on all submitted products, and rejections result in added expense and reduced profit. Reliability, on the other hand, is more elusive: it cannot be measured easily, and, in some respects, it does not offer immediate, positive motivations to a contractor. In fact, one can argue, perhaps cynically, that without a warranty, failures of a deployed system mean more profit to a contractor if the contractor is providing maintenance or spares. In addition, if reliability is a serious problem, the same contractor is probably tasked to develop a fix and to retrofit existing systems.

Figures 3-2 and 3-3 illustrate contractor profit motivation without and with a warranty. Figure 3-2 assumes a no-warranty procurement. θ_{MIN} represents the minimum acceptable reliability, and C_{NW} represents the fixed contract price. The curve represents the equipment production cost as a function of reliability. The difference between the production cost and the contract price is the contractor's profit – the shaded area on the curve. It is clear that, without a warranty, profit increases as reliability decreases. With complete control of reliability, the contractor will produce at θ_{MIN}, because that level maximizes profit and meets the contract requirement.

Figure 3-3, the warranty case, assumes that for each failure that occurs, the contractor has to suffer some costs – through warranty repair, bill-back, or some other warranty remedy. This is represented by the warranty cost curve. The figure shows the total of the production costs and warranty costs. The contract price now includes additional money for the warranty, and the profit is maximized at some point to the right of θ_{MIN}.

The principle represented by the curves in Figure 3-3 is most applicable for the incentive form of warranty. It may also be applied for an assurance warranty, particularly if failure to meet a stated performance level might require redesign as the warranty remedy.

Although these arguments are somewhat theoretical,

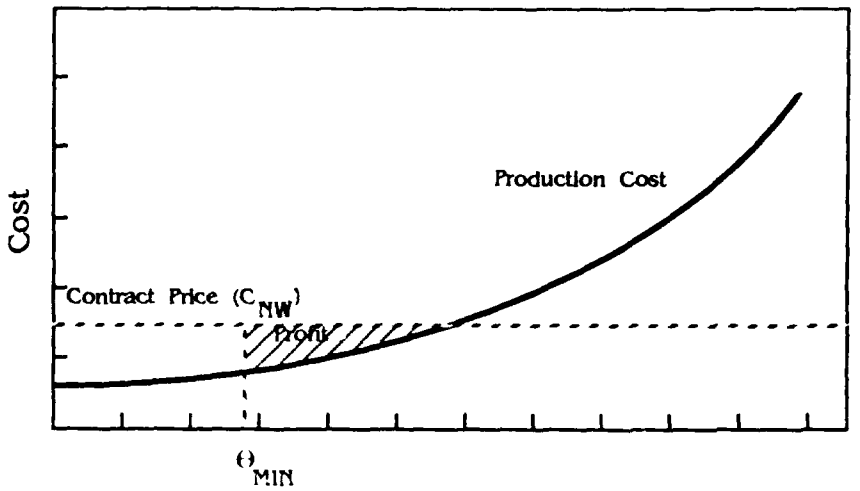

FIGURE 3-2
CONTRACTOR PROFIT MOTIVATION – NO WARRANTY

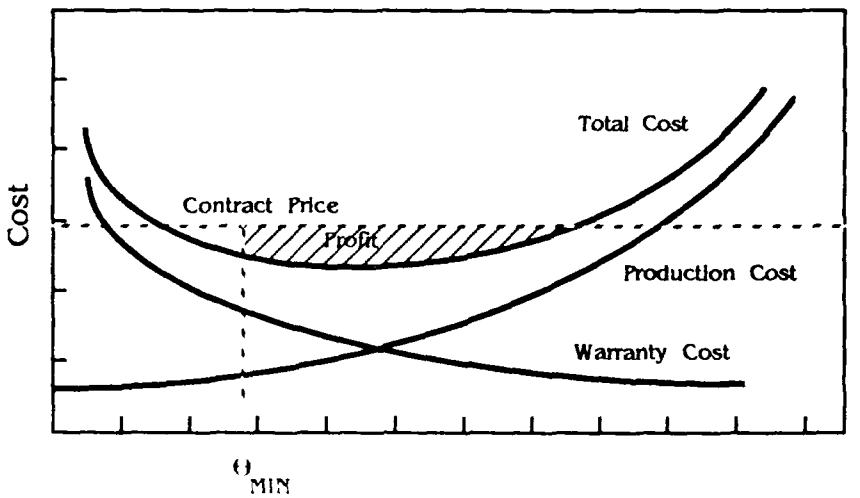

FIGURE 3-3
CONTRACTOR PROFIT MOTIVATION – WARRANTY

the practical aspects associated with a warranty commitment are quite real. Experience shows that incentive forms of warranty do, in fact, properly motivate contractors.

3.5.2 Other Warranty Motivations

There are other motivations, besides reliability, that can be associated with warranty. The warranty commitment forces the contractor to think seriously beyond just having the product accepted. Being involved throughout the warranty period may cause the contractor to be concerned with maintenance, diagnostics, training, data, and other logistics and support factors. As an example, warranties have been written under which the contractor is not reimbursed for processing good units returned unless the percentage of such returns is very high. Since such processing is costly, the contractor may be motivated to improve the built-in test equipment, technical manuals, test equipment, and other elements associated with failure detection and verification.

Another motivational factor concerns maintenance efficiency. If the contractor has to repair all warranted failures, it is important that there be an efficient and effective repair process. There have been a number of instances in which such warranties influenced the contractor to design for maintenance as well as reliability.

When the contractor views warranty as a potential profit source and a means for achieving a competitive edge, a number of positive motivational factors may be present. Producers of quality equipment need not add significant warranty contingency or risk funds to their price to cover future failures, and they need not spend all of their warranty funds to fix a poor product. A warranty environment encourages producers to achieve and maintain a quality product.

3.6 PRICE AND COST ISSUES

3.6.1 Warranty Price Experience

Since passage of the 1984 and 1985 warranty laws, warranty price and cost have become significant issues. In the past, warranties were secured on a very limited basis—often for less than one year—and primarily provided coverage against latent defects. In such cases, the warranties were usually provided to the Government at little or no additional cost. The more extensive warranty forms such as RIW, MTBFG, and LSCG were used for only special cases, and the acquisition budget for the program usually included expected warranty costs. Experience with military RIW programs indicates that, when an RIW is applied to avionics, the warranty price can range from 2 to 7 percent of the hardware price per year of warranty. Thus, if the avionics unit costs $20,000, the price for a three-year RIW can range from $1,200 to $4,200 for each unit. If an MTBF guarantee is included, a price increment of 10 to 25 percent of the RIW price can be expected.

With the warranty statute in force, the typical warranty commitment is greater than the simple forms used in the past to protect against latent defects, but it is not necessarily as demanding as the RIW form. Figure 3-4 summarizes warranty price data for programs under contracts signed after the 1984 law was passed. The range of warranty prices in terms of percent per year of hardware price is 0 percent to greater than 5 percent, with more than half of the prices between 1 and 3 percent. This price range is lower than that observed for earlier RIW programs, which is expected, because the potential liability of most of the newer programs is less than that of an RIW program.

If 1 percent of the hardware price were used as an "average" warranty price for a "typical" assurance type of warranty, an extrapolation could result in the need to spend up to several billions of dollars each year to buy and implement warranties. While this

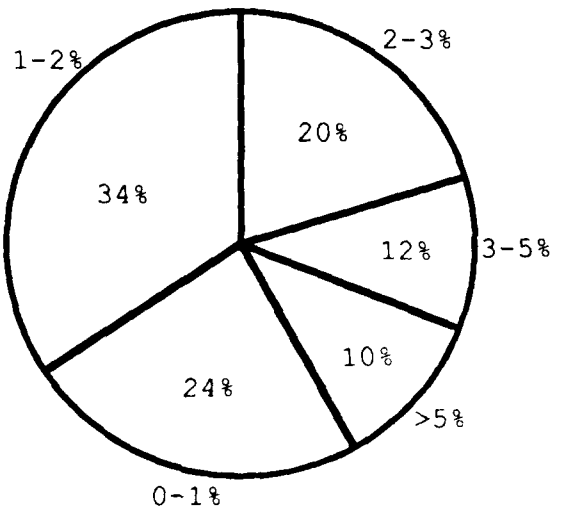

FIGURE 3-4
WARRANTY PRICE AS PERCENT PER YEAR OF HARDWARE PRICE

money may be well spent in terms of the assurance provided in the long term, the financial pressure induced by the warranty law is a very real near-term problem.

3.6.2 Warranty on Current Production Units

If a warranty is to be secured for a unit in current production, the pricing risks are generally minimal. The warranty experience on the previous lots provides data to both the Government and the contractor for assessing risks and potential liability. For satisfactory product, the warranty terms and conditions may be tailored to reduce the coverage (e.g., reduce warranty duration from 12 months to 6 months), thereby reducing warranty price and administration costs. On the other hand, if a problem has been encountered, the warranty terms and conditions may be tailored to help ensure that the correction is made and is appropriate.

3.6.3 Warranty Payment

Warranty payment is usually made with delivery of the hardware, although a pro rata arrangement may be used for the longer-term warranty duration—especially if some form of future contractor service is to be supplied, such as warranty data reports. Generally, the warranty is a separate line item and may be priced as cost per unit of delivered hardware or total cost under the contract. For the longer-term warranties, escalation clauses may also be invoked.

3.6.4 Government Warranty Costs

In addition to the price paid for the warranty, the Government will incur other costs related directly or indirectly to the warranty. Direct costs include those for warranty development and administration, obtaining or providing special data, warranty training, in-plant warranty monitoring, and special transportation. Indirect costs may include those related to increased sparing requirements because of longer pipeline times, decreased breakout and competition opportunities, and reduced self-sufficiency. Since the total of the warranty price and the direct and indirect warranty costs can be significant, the acquisition activity must look to the potential savings induced by the warranty to see if the warranty cost increment is justifiable. This is the basis of warranty cost-benefit analysis, as discussed in Chapter Seven.

3.7 RISK ISSUES

A warranty is not undertaken without risk to both the Government and the contractor. In most cases, the risks can be mitigated through appropriate activities during the acquisition phases and through the writing of tailored terms and conditions.

For all programs examined for which the warranty was well planned and integrated, there was no instance where the warranty caused a serious disruption of system deployment or threatened the viability of the contractor. This is not to say that problems have not occurred. However, there is ample evidence that both simple and comprehensive warranties can be obtained in the military procurement environment that are workable and beneficial to both the contractor and the Government. The Government is "betting" that the penalty or incentive features of the warranty will be strong enough to ensure that product performance requirements will be met. The contractor is "betting" that the warranty money paid will remain as profit. Since good quality and performance will win the bets for both parties, this win-win characteristic should work to structure a warranty where the risks to both sides are acceptable. Table 3-5 lists possible risks that have been identified with warranty procurements.

There are four steps in minimizing warranty risks:

- Include warranty as part of the acquisition strategy.
- Develop and use criteria to select the correct form of warranty.
- Structure the procurement strategy and the warranty terms and conditions to address the risk factors.
- Perform warranty cost-benefit analyses.

Chapters Four through Seven discuss actions to be taken to implement these steps. Table 3-6 presents some specific recommendations to help control risks.

TABLE 3-5

WARRANTY RISKS

Factor	Risk
Characteristic Addressed Under Warranty	The "wrong" characteristic may be selected, thereby focusing effort incorrectly.
Price	It is difficult to estimate expected field performance, which is a basic measure for realistic pricing.
Operational Factors	Field stresses may be difficult to estimate, because of many unforeseen circumstances.
Self-Sufficiency	Contractor repair, if part of the warranty, can reduce military self-sufficiency for wartime-critical items.
Equipment Design	Contractor may design equipment more suitable for meeting the warranty commitment than for meeting the military maintenance environment.
Transition	If required, transition from contractor maintenance to military maintenance can introduce serious administrative and logistics problems.
Administrative Complexity	Procurement and logistics procedures may have to be developed to implement the warranty effectively.

TABLE 3-6

RECOMMENDATIONS FOR WARRANTY DEVELOPMENT

Do
Do involve the contractor, user, support agency, DCAS, and other affected functional elements in the planning process.
Do consider life-cycle cost as one metric for evaluating warranty alternatives.
Do simplify time measurement, termination, and price adjustment to the maximum extent possible.
Do check and double-check to ensure that concepts, terms, and conditions are clear and fully understood.
Do structure terms and conditions to be consistent with operations and support procedures.
Do develop adequate back-up approaches if the warranty cannot be negotiated or implemented.
Don't
Don't commit the contractor to warrant elements beyond its reasonable control.
Don't dilute the fixed-price essence of a warranty to essentially a time-and-materials contract.

Chapter Four
WARRANTY SELECTION AND STRUCTURE

This chapter discusses the selection and structure of specific types of warranties. It first identifies and discusses generic factors that can affect the decision as to the type of warranty to use and the specific terms and conditions. Various warranty alternatives are then considered, and guidance is provided for selecting the right warranty form. Sample warranty clauses are provided that, when properly selected and integrated, can be the basis for developing a final warranty. Finally, a summary is presented of warranty forms applicable to various classes of systems.

4.1 GENERIC FACTORS

The following subsections address factors related to acquisition, the system, and operation that can influence warranty selection and warranty terms and conditions.

4.1.1 Acquisition Factors

The following acquisition factors can affect the selection and structure of an effective warranty:

- *Development history*—Detailed data available on the system should be used to determine potential problem areas on which the warranty might focus. Prediction and test data can help define quantitative warranty requirements.
- *Small versus large buy*—The larger the buy, the greater the potential risk to the contractor if warranty terms and conditions are not met. Generally, the severity and scope of the warranty terms may vary as the procurement quantity increases. For a small buy of large, expensive items, the warranty duration can be on an item-by-item basis. For a large unit buy, the warranty duration may be on a population basis, such as a single end date for all units.
- *State of the art*—The greater the technological challenge, the more difficult it will be to structure a fair warranty at an equitable price. Equipment that does not "push" the state of the art or that severely pushes the state of the art is a candidate for an assurance type of warranty.
- *Competition*—The degree of competition will normally affect warranty price and the contractor's enthusiasm to undertake or bid a warranty with some risk. Without competition, it is generally better to impose warranty requirements rather than have the sole-source contractor bid. The warranty terms should not inhibit plans for competing future production contracts. For example, use of an RIW rather than organic maintenance may not be advisable if future production contracts are to be competed.

4.1.2 System Characteristics

The following system characteristics can affect the selection and structure of an effective warranty:

- *Electronic versus mechanical*—This characteristic can be important for determining warranty duration and predicting reliability. Many electronic systems have a relatively constant failure rate, which makes warranty duration a less important factor than for mechanical systems subject to wear-out. For example, there are several well-publicized cases of cracks occurring in military aircraft structural members after several years of operation. Because of the greater uniformity of electronic devices, a large body of data has been amassed that is useful for reliability predictions. Thus, there will generally be more confidence in a warranty analysis of electronic systems than in an analysis of mechanical systems with only a limited historical data base.
- *Transportability*—This characteristic refers to the ability to ship failed units for warranty claim

action. Neither units bolted to a ship nor space systems are very transportable; therefore, a warranty remedy involving in-plant contractor repair is not feasible. The degree of ruggedization and the costs of shipping are also factors to be considered in developing warranty terms and conditions that require transporting units to another facility.

- *Field testability*—The ability to determine reliably at an intermediate maintenance facility whether or not a unit is failed is important in establishing a maintenance concept under warranty. For example, if equipment is not available to test units at a base shop, then a large number of units that test OK may be sent to the contractor for warranty action. This can be costly if the contractor can charge for processing non-failed units.
- *Warranty markings and seals*—Units should be clearly marked that they are under warranty, and brief instructions should be provided as to disposition. If a unit cannot be so marked, or if it cannot be protected against unauthorized maintenance (e.g., through seals), the warranty terms and conditions should be adjusted accordingly.

4.1.3 Operational Factors

The following operational factors can affect the selection and structure of an effective warranty:

- *Installation cycle*—The length of time from acceptance of the unit to installation should be considered when establishing the duration of the warranty. Either the average installation period can be added to the length of the warranty, or the warranty can be defined upon installation.
- *Operating cycle*—This factor relates to system usage being one-shot, such as a missile; intermittent, such as an aircraft; or continuous, such as a warning radar. The type of usage can affect the type of reliability performance parameter that is to be controlled, as well as the feasibility and method of measuring success or failure of the item in field use. For one-shot usage, success probability is the most applicable reliability parameter; for intermittent usage, mission reliability or MTBF is generally used; and for a continuously operating system, operational availability is usually appropriate.
- *Existing military maintenance capability*—If a military maintenance capability already exists, a warranty that requires establishing a contractor repair facility may not be cost-effective. This does not rule out alternative forms of remedy that do not require contractor repair facilities.
- *Performance measurement*—The ability to measure performance parameters is critical when establishing the essential performance requirements. Elapsed time indicators on units may be used to record operational usage, and maintenance records may be used to record failures. However, in many cases special data collection methods may have to be implemented or special operational tests conducted..
- *Pipeline factors*—The transportability of the units, the length of the pipeline, the sparing level, and the cost of spares all influence the maintenance concept under warranty. Government repair using bill-back procedures should be used when contractor repair is too costly because of pipeline factors.
- *Self-sufficiency*—In cases where the criticality of the system dictates military maintenance, warranty remedies using bill-back procedures are recommended.
- *Transition*—The need to transition out of warranty can influence the warranty structure. Thought has to be given to a one-time versus a phased transition, especially if the contractor is performing depot maintenance.

4.2 WARRANTY ALTERNATIVES

The following sections identify a number of alternatives to be considered in structuring a warranty.

4.2.1 Assurance Versus Incentive Warranties

The two basic warranty classifications were introduced in Chapter Three. The assurance form of warranty is used to provide assurance that minimum contractual performance and quality requirements are satisfied. The incentive form of warranty provides incentives for the contractor to exceed minimum contractual levels.

The best example of an assurance form of warranty is the Army's expected-failure concept, in which the warranty covers all failures beyond the number expected to occur, consistent with the specified MTBF (this number has been called the threshold). Typical forms of incentive warranty include RIW, MTBFG, availability guarantee, and LSCG.

As indicated in Chapter Three, the degree of coverage and commitment separates the assurance form of warranty from the incentive form. Figure 4-1 provides a decision algorithm to aid in choosing between these two forms of warranty. Although it was devel-

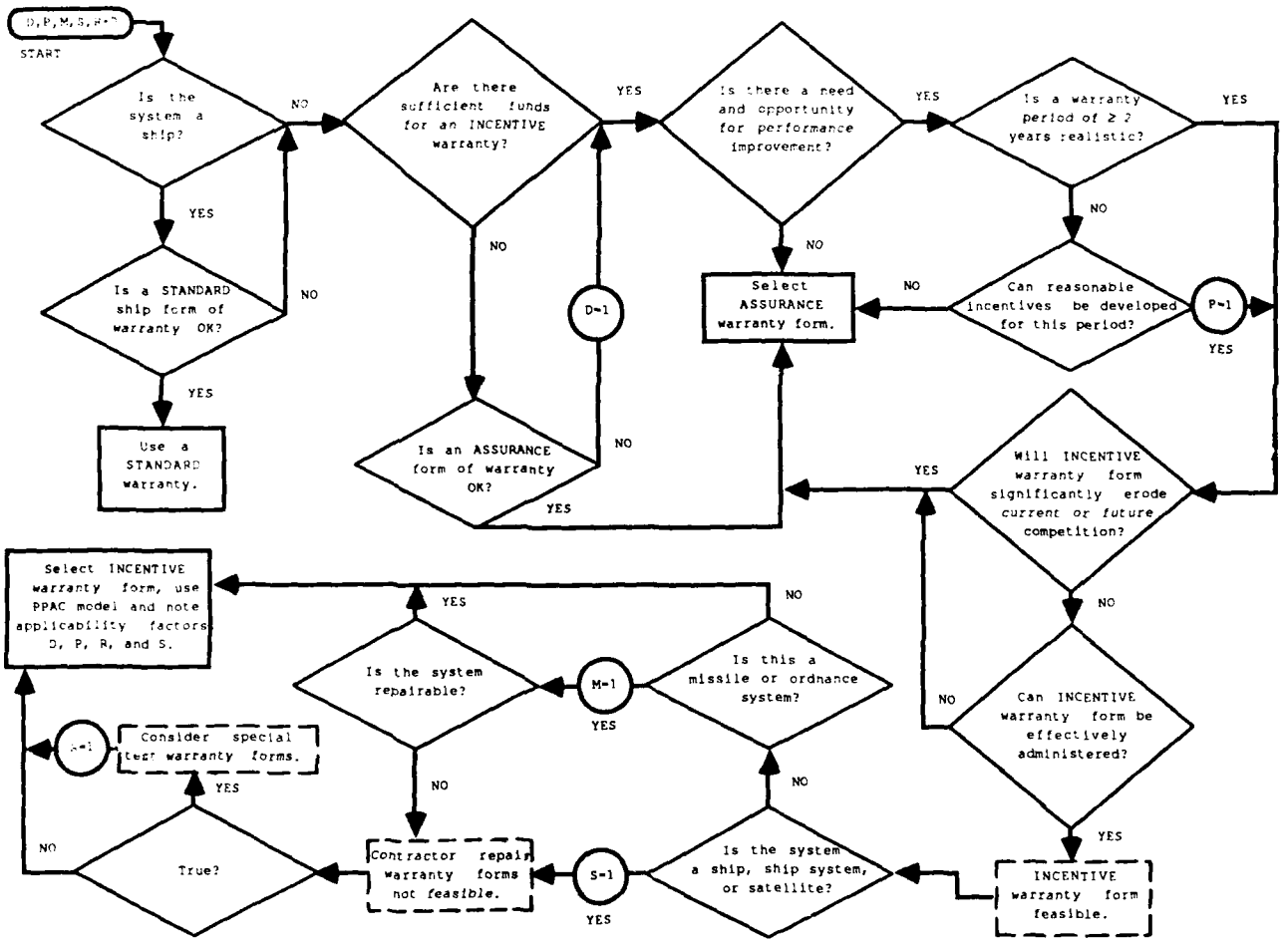

FIGURE 4-1
WARRANTY TYPE DECISION ALGORITHM

oped under a Navy-sponsored research study (Reference 8), the algorithm is generally applicable. The first question on the figure pertains to the fact that the Navy has a standard approach to ship warranties. The question concerning ship systems is asked to determine whether a warranty involving contractor repair is feasible. The algorithm is based on the premise that an incentive form of warranty is most applicable when all of the following conditions hold:

- Money is available for extended warranty coverage.
- There is a need to improve field performance, and there is an opportunity to do so.
- The contractor has significant control of the system capabilities before deployment and can maintain such control during deployment.
- The warranty period can be made long enough to properly motivate the contractor (≥ 2 years).
- An incentive warranty will not seriously erode plans for future competition.
- Warranty terms and conditions can be written to provide adequate compliance determination and remedies.

Not all of these conditions may hold for any one program. Incentive warranty applicability factors are used in the algorithm to denote when one or more of the conditions are violated. These factors are denoted by D (dollars), P (period), M (missile or ordnance), S (ship, ship system, or satellite), and R (repair by contractor).

4.2.2 Individual Versus Population Controls

A warranty can be on an individual system, the population of systems, or both. For example, for the alternate fighter engine program, there are controls on specific fuel consumption and thrust for each individual engine and on shop visit rate for the engine population. Normally, the warranty coverage pertaining to defects in materials and workmanship applies to individual items. Coverage of design and manufacturing requirements and of essential performance requirements may apply to either the individual item or the population. Clearly, a design problem is related to the whole population.

In terms of controlling reliability, an MTBFG usually applies to a population of systems or equipments. However, it is possible to apply such a guarantee to individual units. For example, a contractor may supply several communications satellites and provide guarantees as to the number of communications channels available on each individual satellite.

The type, quantity, and cost of the warranted system will often dictate whether population or individual-item coverage is preferable. Large buys of small items (e.g., avionic units) often have population coverage, while small buys of large units (e.g., C^3 systems) are more amenable to individual-item coverage.

4.2.3 Special Tests Versus Operational Performance Monitoring

When essential performance requirements are selected for warranty coverage, means for determining conformance must be considered. Two approaches are:

- *Special operational testing*—The contract specifies a test for measuring one or more parameters to determine conformance to the essential performance requirements.
- *Operational performance monitoring*—Data are collected during normal operations and used to calculate statistics for measuring conformance to the essential performance requirements.

In some cases, there is a mixing of the two approaches. To discover and correct defects early in the production or deployment phase, testing or monitoring should begin as soon as effective procedures can be implemented.

An example of special operational testing is the approach used to measure reliability, maintainability, and support parameters on an F-16 squadron to implement the logistics support cost guarantee of that procurement (Reference 15). Operational performance monitoring is used on a number of programs for collecting MTBF and availability statistics to implement the provisions of existing guarantees. Standard data collection procedures are modified to permit special calculations to be made to support warranty measurement requirements. This approach was used, for example, on the ARN-118 program to include a means for collecting the average number of days a unit was installed in an aircraft (Reference 12).

Use of a special test procedure allows for direct and accurate measurement of characteristics of interest. However, because of high cost, such tests are generally of a short duration and may not be representative of general usage. Monitoring performance during normal usage allows for a greater sample size but, unless careful control is instituted, is subject to the measurement error inherent in military data collection systems.

4.3 WARRANTY TERMS AND CONDITIONS

This section is designed to help program offices develop warranty terms and conditions that are consistent with program objectives and meet the requirements of 10 USC 2403. Standard clauses are presented within the major categories of warranty statement, contractor obligations, and Government obligations. This method of presentation is used to ensure that warranty writers think about the warranty structure rather than simply copy an existing warranty. Even with this approach, users must tailor the clauses or even develop new ones to fit acquisition, system, and operational conditions peculiar to the procurement.

The following subsections present and discuss sample clauses for various parts of a typical warranty, e.g., identification of the warranted items, type of coverage, remedies, and warranty duration. In practice, warranty statements can be written to combine a number of such parts. For example, the following paragraph covers item identification [1], coverage [2], remedy [3], and duration [4]:

> The contractor warrants that line items _____ [1] are free from defects in materials and workmanship at time of

acceptance [2]. The contractor shall, at no additional cost to the Government, repair or replace any items with such defects [3] discovered within _____ months from the acceptance [4].

4.3.1 Warranty Statement

The following subsections present various alternative clauses that stipulate the basic coverage features of the warranty.

4.3.1.1 Precedence of Warranty Over Inspection/Acceptance

Many military warranty clauses are very specific in ensuring that Government inspection and acceptance does not void or dilute the warranty coverage. A statement similar to the following frequently appears early in a warranty provision:

> Notwithstanding Government inspection and acceptance of supplies and services furnished under this contract or any provisions of this contract concerning the conclusiveness thereof, the contractor warrants that items [names or CLINs] will meet the conditions specified below . . . .

4.3.1.2 System/Equipment Identification

The warranty terms and conditions must clearly delineate the systems or equipment that are to be covered. This can be accomplished by referencing specific contract line items or by defining one or more terms that are then used throughout the warranty provision. In addition, any items of hardware or software that are specifically excluded should be noted.

Line Item Reference. The most commonly used form is reference to specific contract line numbers to define the items covered under the warranty:

> This warranty covers contract line items 001AA through 001AF and each component thereof.

Line Item Reference, Including Replenishment Items. This is similar to the above, except that it is made clear that items installed during the repair process are also covered:

> This warranty covers line items 001AA through 001AF and each component thereof, including items subsequently installed by either the Government or the contractor to correct a defect.

System Definition. A term is defined that is to be used in the warranty in a general way to refer to the items covered:

> The term "system" [or vehicle, computer, etc.] as used herein refers to the highest-level end item furnished under this contract.

System Definition with Breakdown Structure. This extends the system definition approach. The following example is for an engine warranty:

> *Engine*—The word "engine" as used herein means the complete engine assembly.
>
> *Module*—The word "module" as used herein is a major segment of the engine that can be changed at the intermediate level. The following are modules: inlet, fan, core . . . .
>
> *Component*—The word "component" as used herein means an accessory or component as listed in Table X.
>
> *Part*—The word "part" as used herein means those individual items delivered under this contract as part of an engine and not included in the above definitions.

4.3.1.3 Design and Manufacturing Control

This clause covers defects in design and manufacturing as required by 10 USC 2403. If deemed necessary, the definitions section of the warranty can define design and manufacturing requirements as stipulated in DFARS Subpart 46.7.

Standard Design and Manufacturing Control. The following is a standard clause for ensuring conformance to design and manufacturing requirements:

> The contractor warrants that line items will conform to all design and manufacturing requirements specifically delineated in this contract [or reference applicable sections] and in any amendments thereto.

Government-Furnished Property Exclusion. Normally, Government-furnished property, equipment, or

material is not covered in the same way as contractor-furnished equipment. The following clause limits the contractor's liability to GFP installation, modifications, and other work:

> With respect to Government-furnished property, the contractor's warranty shall extend only to its proper installation so as not to degrade the Government-furnished property performance unless the contractor performs modifications or other work on such property, in which case the warranty shall extend to such modification or other work.

4.3.1.4 Defects in Materials and Workmanship Control

This clause covers defects in materials and workmanship as required by 10 USC 2403.

Standard Defects in Materials and Workmanship. The following clause restates the law:

> The contractor warrants that line items provided under this contract are free from all defects in materials and workmanship at the time of acceptance (or delivery) [applicable specifications or contract provisions may be referenced].

Note that this clause ties defects in materials and workmanship to the item's condition at time of delivery or acceptance; that is, it controls latent defects. If a defect is discovered during the warranty period, a dispute might arise as to whether the defect did, in fact, exist at the time of delivery or acceptance. One way to avoid such a dispute is to not use the phrase "at time of acceptance or delivery." With this deletion, all failures during the warranty period are covered, but the coverage has much broader implications—including costs. (See the discussion in Section 3.2.2.2 regarding a potential conflict with a reliability requirement as part of the warranty.)

Coverage of All Defects, Whether at Time of Delivery or Not.

> The contractor warrants that line items [CLINs] provided under this contract are free from defects in materials and workmanship and will remain free from such defects for a period of _____, starting from _____.

Presumption of Defect at Time of Delivery. To reduce the chances for disputes without broadening the coverage as much as the above statement does, a statement such as the following can be used that places the burden of proof on the contractor:

> It is presumed that all defects in materials and workmanship that occur during the prescribed coverage period existed at the time of delivery [or acceptance], unless the contractor can present to the Government clear and convincing evidence otherwise.

Coverage of All Removals, Including Items That Test Good. Sometimes removed items that are sent back to the contractor for warranty action will test good at the contractor's facility. One way to place all responsibility on the contractor is to include all removals as part of the warranty coverage, as follows:

> Any warranted items removed from the system on the basis of a malfunction indication in accordance with applicable T.O.s shall be considered defective, even though tests at the contractor's plant reveal otherwise.

4.3.1.5 Essential Performance Requirements

This section of the warranty differentiates 10 USC 2403 from earlier warranty approaches. It is primarily designed to ensure that the deployed system performs as specified.

Delineated Essential Performance Requirements. The guidance and military service policy statements of DFARS Subpart 46.7 generally direct that only selected requirements be included. Thus, use of a statement of the form, "the contractor guarantees that all performance requirements in this contract will be satisfied," is not advised. A more satisfactory approach is as follows:

> The contractor guarantees that, for the time period specified, designated line items will conform to the essential performance requirements, which are delineated as follows:

Line Item	Essential Performance Requirement
1-1	EPR-1
1-2	EPR-2
⋮	⋮

In many situations, reliability may be used as the top-level parameter to encompass the major performance requirements. Reliability represents the capability of the system to perform satisfactorily. Thus, in a global sense, reliability can include catastrophic failure (e.g., a short circuit of an electronic module) as well as design or performance failure (e.g., inability of a radar to locate or track a target).

The parameter frequently chosen to measure reliability is mean time between failures or similar measures such as mean time between corrective maintenance actions. Sample clauses in which a reliability-related parameter is used as the essential performance requirement are presented below.

Mean Time Between Corrective Maintenance Actions — Individual System. The following provides a control on MTBF for each delivered system and is applicable for small buys of very large units:

> The contractor guarantees that each XYZ system will maintain a mean time between corrective maintenance actions of _____ hours for the period specified in paragraph _____.

MTBF Control of Population. For smaller units, it is usually better to place the reliability control on the population of units:

> The contractor guarantees that the MTBF for the population of all delivered systems will be _____ hours when measured in accordance with the procedures delineated in paragraph _____.

Missile Storage Failure Rate. For a missile, a storage failure rate may be used as a reliability parameter:

> The contractor guarantees that the average storage failure rate of the XYZ missile shall be no greater than _____ throughout the period of this warranty.

Other reliability-related measures for missiles that have been used include availability, alert reliability, captive-carry mean time between failures, storage reliability, and pre-launch reliability. Note that any essential performance requirement may vary over time. In several programs where MTBF was an essential performance requirement, reliability growth was incorporated. Thus, if the final MTBF of a system is to be 100 hours and there are three warranty measurement periods, it may be reasonable to require a 75-hour MTBF for the first warranty measurement period, 90 hours for the second period, and 100 hours for the final period. For some systems a degradation may be allowed, such as for missile storage failure rate or for reliability levels of mechanical systems.

Engine Performance Parameters. Engine warranties provide good examples of essential performance requirements not specifically related to reliability. For example:

> The contractor warrants that the performance of each engine delivered, for the period specified, shall not be less than 95 percent of the intermediate thrust as set forth in specification ABC and shall not exceed 104 percent of the intermediate fuel consumption as set forth in specification DEF.

There have been instances of unclear statements regarding a performance requirement. For example:

> Each system will be serviceable in accordance with the procedures specified in applicable technical orders and maintenance manuals.

Just what "serviceable" means is not at all clear. Such a broad requirement can lead to definition problems and possible warranty disputes if maintenance problems with the system occur later. Rather than use the technical orders and maintenance manuals as the reference (involving hundreds, if not thousands, of pages), some specific higher-level parameters should be identified for warranty coverage, such as mean active repair time, which can serve as a surrogate for "serviceability."

Failure Threshold. For an assurance form of warranty in which the contractor is liable only for failures that exceed a threshold, a typical clause is as follows:

> A threshold number of _____ valid warranty failures of depot-repairable parts is established during the specified warranty period. The contractor shall be liable for the repair/replacement costs of all valid warranted failures that exceed this threshold number during the warranty period.

4.3.1.6 Warranty Duration

The period of the warranty is a major element. War-

'anty cost, incentives, administrative factors, investment decisions, risks, and other factors are all keyed to the duration. The duration of a warranty can be expressed in many ways, including the following alternatives:

- Duration applies to individual items versus lots.
- Duration starts with delivery (or acceptance) versus installation versus some other event.
- Duration is in terms of calendar time, operating time, or a combination (e.g., whichever comes first).
- Warranty period can terminate early or be extended, depending on the item's performance.

Sample clauses follow.

Calendar Period—Population

> The duration of this warranty shall be for 24 months, starting with acceptance of the first item delivered under this contract.

Calendar Period or Operating Hours—Population

> The duration of this warranty shall be for 24 months, starting with delivery and acceptance of the first aircraft under this contract, or 20,000 total aircraft flying hours, whichever occurs first.

Calendar Period—Individual Item

> Each system delivered shall be under warranty for a period of 24 months, starting with the item's date of acceptance.

Calendar Period—Tied to Last Delivery

> The period of the warranty means the period of time running from the date of acceptance of the first system delivered under this contract until 12 months after the date of acceptance of the last system delivered under this contract.

Operating Time—Unit Basis, Using a Run-Time Meter

> The warranty period for each delivered end item shall commence upon acceptance and shall continue until the end item has accumulated 400 hours of operation. The hours of operation will be measured by a run-time meter, which records operating time when power is applied.

It is possible to exclude run-time accumulation when the unit is returned to the contractor for repair, but procedures must be set up to do so and to monitor the recordkeeping.

Multiple Options—For Warranty Termination

> The warranty period shall extend from date of acceptance by the Government to whichever of the following first occurs:
>
> (1) One year
> (2) Accumulation of 850 miles
> (3) 175 hours of operation
> (4) 300 rounds fired

Varying Periods—Different End Date for Different Coverages

> The contractor's obligations under this warranty clause apply (1) with respect to the performance guarantee, only to defects discovered within 6 months after acceptance; and (2) with respect to the design and manufacture and materials and workmanship guaranties, only upon discovery of any breach of warranty within 12 months after acceptance.

Extension of Warranty Period. When the warranted item is a major weapon system, it may be reasonable to extend the warranty period if a warranty breach causes a serious disruption of service. A typical clause of this type for a ship is as follows:

> The guaranty period for each vessel shall be extended by the time during which such vessel is not available for unrestricted service by reason of any defects for which the contracting office shall determine the contractor to be responsible.

Normally, warranty end dates for small units should not be extended in such a manner, because of the large administrative burden this will impose—especially if a single end date was used initially. Control on turnaround time of units returned to the contractor for warranty action can be invoked to cover lost use time for smaller items (see Section 4.3.2.1).

Clarity is important in specifying duration. The following clause can be interpreted several ways and is therefore not recommended:

> For 12 months after acceptance by the

Government, all line items shall _____ _____ .

Does the 12-month period start with each item? The first item? The last item?

Table 4-1 summarizes various options related to warranty duration, using operate time as the primary usage parameter.

4.3.1.7 Conformance Determination

The warranty terms and conditions should be clear regarding how conformance to the stipulated requirements is to be verified. Many warranties that have been written have no specific clause regarding conformance determination, particularly with respect to defects in materials and workmanship and design and manufacturing. Sometimes reference has been made to applicable technical orders or maintenance manuals. The implication of not having a specific verification procedure is that a unit returned for warranty correction is presumed to be defective. If the contractor disagrees, the disputes clause of the contract is invoked. To minimize potential disputes, it may be prudent to either state a presumption of failure and place the burden of proof on the contractor, or specify a failure-verification procedure. Examples follow.

Presumption of Failure

> It is presumed that all items sent back for a defect in materials and workmanship or in design and manufacture are covered by this warranty, unless the contractor can present clear and convincing evidence to the Government otherwise.

Specified Verification Test Procedure

> Units returned for warranty correction are presumed to be defective, unless the contractor can show otherwise, using the applicable test procedures specified in document XYZ.

Reference to Special Test with Contractor Witness Privileges. For the more complex performance guarantees such as mean time between corrective maintenance actions, the warranty must include measurement or verification procedures. For such incentive forms as a logistics support cost guarantee or an availability guarantee in which special test procedures are required, the conformance clause can be quite complex. A general statement used to indicate a special test to verify conformance is as follows:

> During the period specified in paragraph _____, the Government will conduct an operational countdown test in accordance with the procedures specified in document XYZ in order to verify conformance to the stipulated essential performance requirements. The contractor may witness such tests at no additional cost to the Government. The contractor shall be given notice in adequate time to send representatives to the test site.

MTBF Guarantee—Example Using a Standard Data Collection System. If an MTBF guarantee or similar control on a population performance measure is to be used, the measurement or calculation procedures must be stipulated:

> MTBF will be calculated every six months, starting _____ . The MTBF calculation formula is
>
> $$\text{MTBF} = \frac{\text{total flying hours over the 6-month period}}{\text{total number of valid warranty failures during the 6-month period}}$$
>
> The XYZ data system shall be used to obtain the flying hour data for the population of the ABC aircraft. All units repaired or replaced under this warranty during the measurement period shall constitute the denominator of the above equation.

MTBF Guarantee—Special Verification Test. Sometimes a special test is conducted for MTBF or some other measure:

> A verification test (VT) shall be conducted jointly by the Government and the contractor to determine conformance to the MTBF guarantee requirement. The test will be based on plan XYZ, agreed to by both parties. The MTBF formula will be total cumulative hours on the units in the test divided by the number of observed unit failures.

4.3.1.8 Exclusions

Warranty exclusions are necessary to ensure contrac-

TABLE 4-1

WARRANTY DURATION ALTERNATIVES

Warranty Duration	Advantages	Disadvantages
Fixed Calendar Period for All Units - All units are warranted for a fixed calendar time at the end of which all units go off warranty. The actual amount of warranty coverage for individual units will vary, and the user must transition from warranty at a single time. Contractor failure and risk exposure will depend on the utilization rate.	Simplest to administer.	Units receive varying amounts of warranty coverage. A sudden shift from contractor to military support could be disruptive. If units are not operated, value will not be received for prepaid warranty expense unless special adjustment provisions are made.
Fixed Calendar Period for Successive Production Lots - The warranty on all units within a production lot expires at a fixed time, but that time varies between production lots. This approach permits an essentially uniform amount of coverage for each unit but results in a situation in which some field units are under warranty and some are not. This may be administratively unacceptable, but it does ease any transition problems. Contractor failure and risk exposure will depend on the utilization rate.	Permits incremental shift in support. Units receive more nearly equal warranty coverage.	Confusion may occur regarding disposition of a failed unit. If units are not operated, value will not be received for prepaid warranty expense unless special adjustment provisions are made.
Total Operating Hours for All Units - All units are under warranty until a total operating-hour level is reached. This type of coverage reduces uncertainty in pricing the warranty with respect to failure exposure, but the date of warranty termination is open-ended. Coverage on individual units will vary, and a means for measuring total operate hours must be established.	Assures that the Government will receive full value for warranty cost.	More difficult to administer than fixed calendar period. Contractor may be liable for an extended period if operational usage is far below expectation.
Operate Hour or Calendar Time for Individual Units - The warranty on each unit expires after a specific number of operate hours or calendar time is reached. This type of coverage is similar to the 12,000-mile or 12-month warranties associated with automobiles. This approach provides uniform coverage and the most information for warranty pricing, but it is administratively cumbersome and might be appropriate for only warranty on such items as large, fixed ground equipment.	Provides contractor limit on time liability.	Requires individual-item operate-time measurement. Administration is most complex. Value may not be received if time expires; however, coupled with an operate-time adjustment, this problem can be minimized.
Total Operate-Hour or Calendar-Time Coverage for All Units - This type of coverage provides for a single end time and limits contractor liability. While time to transition from warranty is not completely specified, it is more predictable than just total operate-hour control.	Provides contractor limit on time liability.	Administration is complex. Value may not be received if time expires; however, coupled with an operate-time adjustment, this problem can be minimized. Requires fleet operate-time measurement.

tor liability only for defects or failures that are under or should be under contractor control. For example, failure of a complex electronic device resulting from its falling off the back of a delivery truck should not be the responsibility of the contractor, unless the contractor was also responsible for the delivery. On the other hand, there is a danger that very general or ill-defined exclusions such as "not used in the manner intended" may offer an escape that the contractor may seek if too many failures occur.

General Exclusionary Clause

> The contractor shall not be liable under the terms of this warranty for any failures that occur as a result of [list of exclusions].

Specific exclusions that have been used in recent warranties include failures caused by the following:

- Accidents
- Acts of God
- Combat damage
- Fire, submersion
- Foreign-object damage
- Government misuse, mishandling, repair, or installation not in accordance with prescribed procedures
- Nonapproved storage, crating, or packaging
- Sabotage, vandalism

Misuse or Mistreatment Exclusion—Tie-In to External Physical Damage. Excluding failures occurring as a result of misuse or mishandling seems reasonable, but often verification that such events occurred is very difficult to obtain. One way this has been handled is as follows:

> The contractor shall not be obligated under these warranty provisions for:
>
> 1. Repair of external physical damage caused by accidental or willful mistreatment by Government personnel
> 2. Repair of internal physical damage (not including electrical damage) that, in the determination of the Government, has been caused by accompanying external physical damage due to mistreatment

Third-Party and Consequential Damages. It is Government policy to exclude the contractor from liability for third-party damage and consequential damage:

> The warranty provisions do not cover liability for loss, damage, or injury to third parties, or consequential damages.

4.3.2 Contractor Obligations

This part of the warranty contains the obligations of the contractor to implement the warranty. The main obligation is the remedy to be taken in the event of a warranty breach. Generally, there are other clauses related to warranty management, data, turnaround time, and storage.

4.3.2.1 Remedies

As indicated in the DFARS guidance, the three basic remedies are:

- Contractor implements a corrective action.
- Contractor pays costs reasonably incurred by the United States in taking necessary corrective action.
- There is an equitable reduction in contract price.

It is possible that two or even all three of these remedies may be invoked—generally at the option of the Government.

Correction of a Defect—Contractor Repair/Replace. A typical clause involving contractor repair or replacement of a defective item is as follows:

> In the event a defect in materials or workmanship occurs as stipulated in paragraph _____ , the contractor shall repair or replace such parts as necessary to restore the item to a satisfactory condition [repair test verification procedures may be referenced]. Each such corrective action shall be performed within _____ days of receipt of the defective item at the contractor's facility.

A number of warranty clauses have been written that use the word "promptly" to control the turnaround time. Use of such a vague term is not recommended.

Average Turnaround—Liquidated Damage Assessment. Instead of a turnaround on each defective item, there might be a control on all such items over a specified period, i.e., an average turnaround:

> Turnaround time shall be defined as the time from receipt of a defective item at the contractor's facility for corrective action to the time the corrected item is ready for shipment or storage. The average turnaround shall be measured for six-month periods for all returned units. If in any

measurement period the average turnaround time exceeds _____ days, then liquidated damages shall be assessed equal to (the number of units returned during the period)×(the excess in average turnaround)×($ _____).

Instead of a monetary liquidated damage assessment for excess turnaround time, there have been assessments in terms of additional spare units or a two-for-one increase in the length of the warranty period.

Correction of a Defect – Government Options. The following correction clause gives the Government the option of using any of the standard remedies:

> In the event of a breach of the contractor's warranty against defects in materials and workmanship or design and manufacture, the Government may, at no increase in contract price:
>
> 1. Require the contractor to repair or replace the defective or nonconforming supplies.
> 2. Require the contractor to furnish the materials or parts and installation instructions required to successfully accomplish the correction.
> 3. Equitably reduce the contract price if both options (1) and (2) are not elected.

The equitable-price-adjustment provision can be made more concrete. For example, for the warranty on the alternate fighter engine, if the Government elects to do the repair, the contract price is reduced by $25,000 for each engine repaired and by $10,000 for each component or part, with a cap of $25,000 for any single failure event.

Performance Requirement Breach – Redesign. The failure to meet a performance requirement may require a redesign. Because such a liability is significant, the warranty should clearly indicate the requirements:

> In the event of a breach of one or more of the essential performance requirements as stipulated in paragraph _____ , the contractor will determine the cause of the breach and develop a solution. If the solution involves a redesign and retrofit, normal DoD-STD-480 configuration control procedures will apply. All costs for engineering analysis, redesign, and retrofit shall be borne by the contractor.

Maximum Liability. The purpose of a warranty is not to put the contractor out of business. For the more risky situations, a cap on liability may be used:

> The contractor's maximum liability under this warranty provision shall not exceed $ _____ .

MTBF Guarantee. The MTBF guarantee often requires that the contractor not only develop a fix to the low-reliability problem, but also provide consignment (loaner) spares in the interim:

> In the event the measured MTBF is less that the guarantee value, the contractor shall, at no additional cost to the Government, furnish the following:
>
> 1. Engineering analysis to determine the cause of the nonconforming MTBF
> 2. Corrective engineering design changes
> 3. Modification of the units, spare units, and spare parts as required
> 4. "Pipeline" unit spares as needed by the Government on a consignment (no-charge loan) basis, but no greater than that provided by the following formula: [Formula that determines amount of consignment spares as a function of the MTBF deficiency, number of warranted units, pipeline time, and spares-sufficiency level.]

Generally, there is a limit to the number of consignment spares that may have to be provided. This form of the MTBF guarantee should also include the requirement for the Government to return the consignment spares if and when the MTBF improves.

Logistics Support Cost Guarantee – Correction of Deficiencies. A generic clause for a remedy applicable to a logistics support cost guarantee is as follows:

> In the event the measured logistics support cost (MLSC) fails to meet the prescribed target (TLSC), the contractor must institute a correction-of-deficiencies (COD) course of action that will bring the logistics cost within the prescribed target. Such action may include development of engineering change proposals (ECPs), provision of additional logistics assets, or both. The contractor's proposed course of

action must be submitted to the Government prior to implementation for review and approval.

4.3.2.2 Transportation

Transportation—Contractor Pays. A number of "standard" or "baseline" warranty clauses suggest that the contractor assume transportation costs. For example:

> When items covered by this warranty are returned to the contractor pursuant to this warranty, the contractor shall pay the transportation costs from the place of delivery specified in the contract to the contractor's plant and return to said place of delivery

Use of a standard place of delivery removes the uncertainty of the liability associated with widespread deployment of the warranted items. Not all clauses specify complete contractor transportation liability. Another approach is for the Government to pay for shipping to the contractor and the contractor to pay for return shipping.

4.3.2.3 Warranty Data and Reports

Data on Correction. The contract usually imposes warranty data requirements to implement certain elements of the warranty such as turnaround time, to assess the effectiveness of the warranty, and to maintain appropriate inventory and configuration control:

> The contractor shall prepare and furnish to the Government data and reports applicable to any correction required under the clause. [Reference applicable DIDs.]

For the more extensive forms of incentive warranty, the Government may want the contractor to provide an assessment of the warranty effectiveness—perhaps through an annual report or a report due at the end of the warranty.

4.3.2.4 Warranty Marking

To ensure that the warranty coverage is not lost, the contractor should be required to mark the units properly. For example:

> The contractor shall apply a permanent warranty notification stamping or marking on each warranted end item in accordance with MIL-STD-130 and, when appropriate, mark each container in accordance with MIL-STD-129.

Such information as expiration date, brief processing instructions, and shipping destination may be specified.

4.3.2.5 Warranty Seals

If the warranty is voided because the Government attempts repair, a clause requiring that suitable seals be installed is advisable:

> The contractor shall design and install seals on the unit so as to preclude unauthorized repairs or tampering. The contractor must adequately demonstrate that inadvertent seal breakage is unlikely. The design of such seals must be approved by the Government.

Inadvertent seal breakage has caused some difficulties in several programs. Seal breakage by itself may not be an exclusionary cause.

4.3.2.6 Installation of Warranty ECPs

The contractor may elect to develop and implement an engineering change proposal (ECP) to reduce future failures. If a Class I ECP is approved, the contractor is normally required to install such ECPs in all units returned for warranty correction:

> The contractor shall install all approved Class I warranty ECPs in units shipped to the contractor during the warranty period.

The terms of the warranty may also make the contractor liable for supplying modification kits for all warranted units that have not been updated to the latest configuration as of the warranty end date. This is typical of an RIW.

4.3.2.7 Technical Manuals

Warranty provisions applicable to using activities should be included in relevant technical manuals:

> The contractor shall include those warranty provisions applicable to using activities in all pertinent technical manuals under this contract.

.3.3 Government Obligations

or the warranty to be implemented efficiently and airly, the Government may have certain obligations ı such areas as administration, testing, notification, ıipping, data, maintenance, and ECP approval. hese areas are discussed in the following ıbsections.

.3.3.1 Warranty Administration

he Government, in its own interest, should establish n effective organization and a set of procedures for dministering the warranty (see Chapter Six). No ıatter how carefully the warranty is constructed, ıere is always the potential for disagreement on overage, failure definition, corrective-action re- ıuirements, or other areas.

he following specific clauses are related to overall dministrative and contractual matters.

Cancellation of Coverage

> The Government has the option of canceling the warranty coverage on any system prior to delivery and acceptance, and receiving an equitable adjustment.

Evidence for Warranty Adjustment Claim

> The Government will take all reasonable steps to preserve adequate evidence substantiating its warranty equitable adjustment claim for [state reason(s) for claim].

Government-Directed Corrective Action. If there is disagreement as to whether a warranty breach has occurred, the Government will generally be obligated to direct the contractor as to the disposition of the item:

> Notwithstanding disagreement as to the existence of a deficiency, the contractor shall implement the corrective action directed by the contracting officer. If it is determined at a later date that no deficiency existed, the contract price will be equitably adjusted.

4.3.3.2 Testing and Verification

The Government may obligate itself to perform certain field tests and verification procedures so as to ensure that the item is in fact defective and that causes for a warranty exclusion are not evident.

Testing – Special Performance Test

> The Government will perform product verification tests at [test site] as described in paragraphs A and B as a means of verifying that the items meet the performance requirements stated in the contract.

Testing – Field Failure Verification

> The Government shall, to the extent practicable, verify that the warranted item has failed, using appropriate procedures and test equipment [specific procedures/equipment may be referenced].

Verification of No Tampering

> The Government shall verify at authorized maintenance facilities that tampering or unauthorized maintenance has not occurred.

4.3.3.3 Notification

A typical statement of the Government's obligation to notify the contractor is as follows:

> The contractor shall be notified in writing of any warranty breach within _____ days after discovery of the breach.

In many cases, this is followed by a statement that the contractor is not relieved of the warranty obligation if timely notice is not provided.

4.3.3.4 Shipping

To minimize damages during transportation, a clause similar to the following may be included:

> All shipping containers will be provided by the Government and will meet the protection requirements of container specification XYZ.

No Batch Shipments. If a turnaround time requirement is imposed on the contractor, the Government may be obligated not to batch-ship failed items.

> The Government shall promptly ship each nonconforming item to the contractor and not batch shipments.

4.3.3.5 Data

Data available to the Government may help the contractor perform failure analysis and repair. The Government may be obligated to provide such data with a clause similar to the following:

> The Government will make available to the contractor, in a timely manner, all data relating to the defective supplies, including [data report references].

4.3.3.6 Maintenance

To protect itself and the contractor, the Government may obligate itself to use properly trained maintenance personnel and procedures:

> The Government shall ensure that its personnel or designated representatives are properly trained and will perform maintenance on the system in accordance with the most recent technical orders.

4.3.3.7 ECP Approval

If the contractor submits a no-cost ECP to correct a problem that is causing a warranty breach, the Government should expedite processing, especially if the item is still in production. The following clause indicates such intent:

> In recognition of the high contractor motivation for total cost control effected through these warranty provisions, the Government agrees that all no-cost ECPs submitted in accordance with MIL-STD-480 to improve reliability and maintainability for the units will receive special, expeditious processing. Notwithstanding this special processing, any such ECP shall be formally incorporated in the contract by the Government _____ days after receipt by the PCO, unless the contractor has received written notification of its nonapproval from the Government prior to that date.

4.4 SPECIFIC WARRANTY FORMS

The following subsections summarize warranty forms applicable to various system classes. The summaries are based on system characteristics as well as studies of sample warranties procured both before and after passage of 10 USC 2403.

4.4.1 Avionics and "Black Boxes"

Typically, avionics and black-box units are transportable, self-contained, and capable of being clearly marked. Therefore, they are amenable to warranties involving contractor repair. If organic depot capability already exists, the bill-back procedure may be most appropriate for an assurance warranty form. Despite advances in built-in test equipment, a number of removals from aircraft that are verified at the base still test good at the depot. Therefore, the problem of unverified failures (test goods) must be addressed. Typically, for a contractor repair situation, the repair level is established to be the line replaceable unit (LRU) or weapon replaceable assembly (WRA), but module or shop replaceable assembly (SRU)-level warranties have also been used.

4.4.2 Fixed Ground Systems

For large ground installations such as a command, control, and communications (C^3) system, the warranty approach of a logistics support cost guarantee has merit. Collecting the necessary data to implement such an approach is much easier than doing so for widely dispersed smaller items. The system must be supplied by a single prime contractor. If there are a number of suppliers and the using activity has its own maintenance capability, bill-back under a standard assurance warranty form may be sufficient. If the system is used continuously, some form of availability guarantee may be applicable.

4.4.3 Vehicular Systems

Many of the vehicles purchased by the military services use forms of commercial warranties. If the military has maintenance capability, Government maintenance with bill-back is preferred. For a new unit on a current design, a special warranty may be developed—e.g., RIW or MTBFG for a new engine module, and "standard" bill-back warranty for the rest of the vehicle. For noncommercial types of vehicles, the Army has used the expected-failure concept (threshold failure number).

4.4.4 Ships and Ship Systems

Ship warranties traditionally start at the time of preliminary acceptance and last during the sea trial period, typically six to nine months. For such trials, which include final contract trial and post-shakedown availability, the ship is fully equipped and armed and is operated by Navy personnel, with contractor representation as approved by the Government.

Defects that are found are corrected by the contractor within the provisions of the incentive price contract typically used for ship procurement. Final acceptance by the Government is regarded as conclusive.

Ship systems are somewhat unique, in that they may be "bolted to the ship," and repair capability varies with ship size. Since repair capability can vary, a warranty that allows for the Government to select repair options may be prudent. Thus, failures of a warranted system on an aircraft carrier may be repaired by Navy personnel, while similar failures on a smaller vessel may be transported back to the contractor for warranty action.

4.4.5 Missile Systems

Warranties on missile systems generally depend on the conduct of a number of tests to verify that established performance parameters are satisfied. In most cases, the parameters are related to reliability or availability, such as storage failure rate, ground check-out reliability, captive-carry MTBF, launch success rate, and operational availability. Often data from a number of different types of tests and operations are combined. For example, for the air-launched cruise missile, data from prelaunch tests, operational test launches, joint test assembly launches, random testing of stored units, and operational readiness tests were all used to implement the availability guarantee provisions of that contract.

4.4.6 Satellite Systems

Warranties on satellite systems typically include guaranteed performance measures with positive and negative incentives. Thus, the number of available communication channels on a year-to-year basis may be guaranteed over the expected life of the satellite. If more channels are available than guaranteed, the contractor receives a positive incentive or award-fee payment. If fewer channels are available than guaranteed, a penalty or negative-incentive features are invoked.

Chapter Five
WARRANTY DEVELOPMENT

This chapter provides guidance to the program manager in developing and structuring an effective warranty during the acquisition phases. The chapter first reviews warranty-related activities from a system life-cycle perspective as well as a number of key warranty planning and development activities that should be accomplished early in the system's life cycle. Specific recommendations are then provided for warranty planning and development during the Concept Exploration, Demonstration/Validation, and Full-Scale Development phases of the acquisition cycle, including studies, requirements, RFP development, proposal evaluation, and final negotiations. Note that for very simple forms of assurance warranty, not all activities described in this chapter may be required.

5.1 WARRANTY AND SYSTEM LIFE CYCLE

This section provides a general overview of warranty-related activities from a system life-cycle perspective. In developing an effective warranty, the program manager needs to plan for the completion of these activities. This section also addresses warranty impacts on the acquisition strategy and procurement plan, the system specification, and the program office organization as key planning factors for the program manager to consider early in the system's life cycle. Contractor risks are also considered.

5.1.1 Life-Cycle Overview

Figure 5-1 shows how warranty-related activities interface with the system life cycle. These activities are summarized by phase as follows:

- *Concept Exploration*—Technical and support concept studies are performed for identifying characteristics to consider for warranty.
- *Demonstration/Validation*—The expected warranty provisions are developed as system requirements to be addressed in Full-Scale Development.
- *Full-Scale Development*—The warranty provisions are updated to reflect better estimates of system R&M, support parameters, and costs, and are included in the production RFP.
- *Production*—A series of tasks is developed to implement, enforce, and manage the warranty provisions.
- *Operation and Support*—The warranty provisions are administered.

Activities in the Concept Exploration, Demonstration/Validation, and Full-Scale Development phases are discussed in Sections 5.2 through 5.4, respectively; activities in the Production and Operation and Support phases concerned with warranty implementation and administration are discussed in Chapter Six.

5.1.2 Acquisition Strategy and Procurement Plan

To obtain maximum effectiveness from the warranty concept, it is important that the concept be considered early in the system's life cycle, because decisions on the warranty approach can affect equipment configuration and design as well as the planning needed to maintain and support the warranted item.

The RFP for Demonstration/Validation may include sample warranty provisions that notify the contractor of the warranty performance requirements being considered for the production system. The sample warranty provisions should be qualitative descriptions of the warranty coverage desired. Actual warranty requirements should be defined only after system performance experience is accumulated and evaluated from analyses and tests performed during Demonstration/Validation.

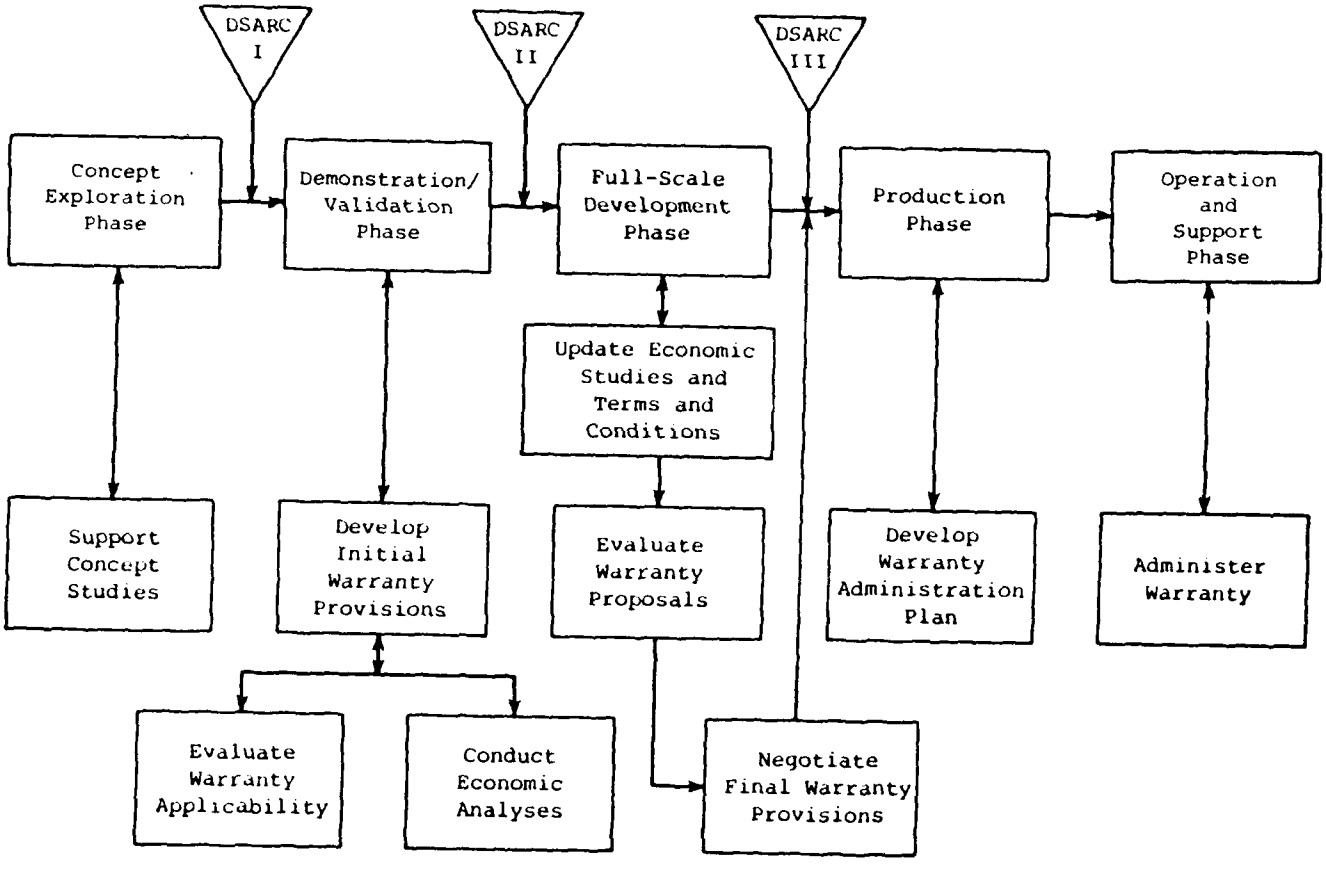

FIGURE 5-1
WARRANTY AND THE SYSTEM LIFE CYCLE

The program manager may decide to include a detailed warranty requirement in the RFP for Full-Scale Development (FSD) to indicate the warranty coverage expected for production units. The program manager would develop the warranty requirements from the system performance characteristics determined during Demonstration/Validation as well as further engineering studies and cost-benefit analyses. In addition, the program manager may decide to have the FSD contractor propose alternative forms of warranty that would be more advantageous to the Government.

If the FSD contractor is expected to provide production units later, the program manager may decide to include the warranty provisions in the FSD contract, with the options for production already priced. This strategy, which was used for the F-16 FSD contract, provides competition for warranty pricing. It is viable if a single production source is expected (the FSD contractor) and if warranty terms and conditions and pricing can be developed at the early date. The Government would have the right to change the warranty provisions and negotiate price changes as the system matures and opportunities for a more cost-effective warranty arise.

Table 5-1 presents a general sequence of steps for developing a warranty approach, starting early in the system's life cycle. Those steps which are applicable to the procurement should be included as part of the acquisition strategy for the weapon system.

5.1.3 System Specification

A key element in the development of an effective warranty is the system specification, which defines the set of system requirements. It is generally developed

TABLE 5-1

WARRANTY DEVELOPMENT STRATEGY

1. Perform studies to identify essential performance characteristics to consider for warranty and identify candidate approaches.

2. Develop criteria and models and collect applicable data to perform evaluations to decide between assurance and incentive types of warranty.

3. In conjunction with technical, user, logistics, and contractual personnel, develop candidate approaches and assess the feasibility of candidate approaches, including consideration of warranty implementation and administration.

4. Develop preliminary clauses or draft provisions for Demonstration/Validation RFP, or provide "trial balloons" to potential contractors to obtain industry comments.

5. Issue an FSD RFP with "expected" warranty provisions for the production contract, or have contractor propose alternative forms of warranty to the Government.

6. Finalize warranty terms and conditions for the production RFP.

7. Develop a warranty selection strategy and decision model.

8. Issue an RFP with a warranty option.

prior to completion of the Demonstration/Validation phase. The requirements in the system specification (Type A specification) are translated to development specifications (Type B), generally before or at the beginning of FSD. Product, process, and material specifications (Types C, D, and E, respectively) are applicable to the production equipment. Requirements in the system specification can be in terms of design details or performance, or, as is most likely, a combination of the two. Performance requirements are preferred, to interest the largest segment of industry for competitive bidding. Performance requirements also allow greater flexibility in establishing warranty requirements. If the specification establishes detail design requirements, there is potential for future dispute if the design does not yield the required performance, because the contractor can claim that the design was imposed.

General DoD policy has stated that warranty should not apply to goals or objectives. In addition, qualitative statements cannot be meaningfully used without a potential for dispute. Thus, a requirement such as, "the XYZ system shall have high reliability when used in the manner intended," must be translated to a numerical reliability requirement that is unambiguous and can be measured to determine conformance. Although such a translation can be accomplished any time before the production RFP is issued, it is much more effective if the specific requirement is imposed as early in the program as possible. In that way, the contractor community knows what is expected and knows that such a requirement may become a warranty performance requirement. The prudent contractor will then plan the program in such a way that the future warranty commitment can provide a competitive edge and possibly be a profit-maker. Specific recommendations for including requirements in the specification, giving consideration to warranty development, are as follows:

- Requirements in the system specification and flowdown specifications must be quantitative.
- For requirements to be directly used for warranty coverage, they must clearly refer to the operational environment or special test conditions.
- Methods for measuring conformance to requirements must exist or be amenable to development.
- Only a small subset of specification requirements should be selected for warranty coverage.
- Higher-level, mission-related requirements are generally preferred to sublevel requirements for warranty specification (e.g., speed instead of engine and air-flow parameters, system MTBF instead of unit MTBFs).

5.1.4 Program Office Organization

It is important that the program or system manager plan and coordinate a warranty application early in the system life cycle. The selected warranty approach can affect equipment configuration and design as well as the planning needed to maintain and support the warranted item.

The program office represents the first logical coordination point for ensuring that the warranty is developed and implemented effectively. Program, engineering, logistics, budget, and contract personnel need to know the warranty application at hand and the areas of risk where inconsistency between the warranty and program requirements could void the warranty requirements. For example, Government decisions during the functional configuration audit process could affect either warranty performance requirements in the operational field environment or the contractor's liability for engineering redesign as a remedy in ensuring essential performance.

Functional interfaces between program office, user, and supporting activities are also important in ensuring that the maximum benefit from a warranty application is received. These interfaces identify the multiple features of a warranty application, including the following:

- Warranted items, coverage, and duration
- Maintenance and handling procedures for warranted equipment
- Transportation management
- Inventory management
- Communication of warranty claims
- Defense Contract Administration Services (DCAS) responsibilities
- Configuration management
- Funding
- Warranty data reporting
- Special training for warranty implementation

A warranty implementation plan (discussed in Chapter Six) is the program manager's vehicle for describing these features of a warranty application, identifying organizational responsibilities, and establishing procedures and interfaces required for successful implementation and management of the warranty.

The program manager can receive assistance from service and DoD activities in planning and developing a warranty application. The Product Performance Agreement Center (PPAC) at Wright-Patterson Air Force Base serves DoD programs with available warranty data bases, including standard clauses and decision and cost analytical modeling techniques and procedures. The program manager can query PPAC for the current service and command activities providing the most recent policy and guidance on warranty implementation and management.

5.1.5 Contractor Risk Considerations

For many new procurements, there are significant technical, operational, schedule, and financial challenges. Warranty is sometimes considered as one effective means of shifting part of the development and acquisition risks to the contractor. However, if consideration is not given to the risks the contractor faces in undertaking a warranty, the effectiveness of the warranty is threatened. Warranty price will increase as the perceived risk increases. If, during the warranty period, the contractor is faced with extraordinarily large losses, the viability of the program may be threatened. The "bet your company" approach is generally not advocated. Table 5-2 lists a number of contractor risk factors and approaches to reducing their effect or eliminating them.

5.2 CONCEPT EXPLORATION PHASE

The program manager evaluates and selects alternative system development concepts for meeting the stated mission need. The concepts should address the functional and performance characteristics necessary to meet the mission need, as well as the necessary interfacing capabilities, and should be accompanied by preliminary life-cycle-cost estimates and logistics supportability plans. Table 5-3 lists major acquisition activities in this phase and identifies areas of interface with the development and implementation of warranty application.

Although the system is treated in very general terms in this phase, background studies may be conducted in terms of reliable system performance and the expected life-cycle cost. Warranty or other control methods (e.g., award fee, performance incentives) may be considered as part of the studies as a means of achieving stated goals for reliable performance pursuant to 10 USC 2403 and of maintaining costs within resource limitations. The Concept Exploration phase ends with the development of a system concept paper, which may state the initial requirements for using warranty control techniques.

TABLE 5-2

CONTRACTOR RISK FACTORS AND RISK-REDUCTION APPROACHES

Risk Factor	Risk-Reduction Approach
Late Notification of Intent to Use Warranty	The contractor should be aware of the intent to use warranty as early as possible during engineering development so that there will be maximum oppotunity for design optimization.
Detailed Government Specification of Item Design	The use of functional specifications should be maximized to allow for design flexibility.
Application of Incentive Warranties to Advanced Technology	Incentive warranties may not be appropriate for completely revolutionary design. When applied to new technology, the program funding and schedule should allow for adequate reliability test effort. A cost-sharing warranty agreement could be considered.
Reliability-Prediction Uncertainty	The Government should specify only a minimum acceptable level of reliability. Operational and environmental data should be provided to the contractor. Adequate time and funding for necessary reliability testing should be included in the development contract.
Unpredictability of Inflation Rates for Long-Term Agreements	The warranty price should be coupled with economic adjustment provisions to account for inflation.
Failures Outside Contractor Control	Exclusions should be provided; they would normally include acts of God, fire, explosion, submersion, flood, combat damage, accident, and unauthorized tampering by Government personnel. Exclusions for mishandling should be carefully worded.
Large Number of Unverified Failures ("Test Goods") Returned to Contractor	Contractual provisions should be carefully tailored so that costs of processing returns are equitably shared.
Item Usage Rate Not Precisely Known	The contract should provide for a price adjustment for significant usage-rate variations or possibly have a cut-off on total operating time.
Data Not Supplied to Contractor as Required	Contract provisions should include Government responsibilities for meeting data obligations in a timely manner. Contractor obligations for warranty performance may be related to receipt of applicable data.
Uncertainty About Shipping Destinations of Warranted Items at Time of Bidding	If there is significant uncertainty about shipping costs, the Government should assume those costs.
Effect on Turnaround Time of Events Not Under Contractor's Control (e.g., Strike and Uneven Flow of Failed Units)	Relief from turnaround time obligation for specified conditions should be included as part of the contract.
Time-Consuming Procedures for ECP Approval	Warranty provisions should provide for expeditious approval of ECPs - perhaps by automatic approval - unless notification is given within a certain time limit.

TABLE 5-3

CONCEPT EXPLORATION PHASE ACQUISITION ACTIVITIES AND WARRANTY INTERFACES

Acquisition Activity	Warranty Interfaces
Requirements Analysis	Identify key parameters as candidates for essential performance requirements coverage.
Functional Analysis	Relate key performance parameters to applicable hardware/software elements.
Trade Studies	Analyze various warranty strategies and interfaces as trade studies are conducted in requirements, configuration, and supportability.
Technology/Risk Assessment	Identify potential warranty approaches to addressing risks that are identified.
Logistics Supportability	Consider impact of various warranty support strategies on overall logistics support structure.
LCC Assessment	Identify major LCC factors to consider in conducting a warranty cost-benefit analysis.
Acquisition Strategy/Plans	Identify/update major warranty alternatives.

5.3 DEMONSTRATION/VALIDATION PHASE

The program manager identifies the system development concepts and approaches that have the greatest potential for meeting the mission need in the most cost-effective manner. The concepts are verified, and the associated risks and uncertainties are identified and, where possible, resolved, usually through hardware fabrication and demonstration. System and subsystem documents as well as solicitation documents are completed to the extent necessary to support contracting for the Full-Scale Development of the selected concepts. Table 5-4 lists major acquisition activities in this phase and identifies areas of interface with the development and implementation of warranty application.

Although warranty application is generally associated with the production contract, it is important that the system developer understand the warranty requirements, since the requirements may affect design, production processes, parts selection, and quality control in an effort to enhance reliable system performance. The RFP for Full-Scale Development should contain preliminary warranty provisions intended to be used for the production contract.

Program contracting or logistics office personnel perform studies to determine a warranty approach to the weapon system and identify preliminary terms and conditions for the warranty. Major studies related to warranty are summarized as follows:

- *Initial screening* – Initial screening is performed in accordance with application criteria established in Chapters Three and Four to determine if one or more warranty alternatives are appropriate.
- *Economic analysis* – If the results of the initial screening are positive, the candidate warranty alternatives are analyzed to determine the economic feasibility of warranty and the most desirable warranty period. The procedures used are provided in Chapter Seven.

TABLE 5-4

DEVELOPMENT/VALIDATION PHASE ACQUISITION ACTIVITIES AND WARRANTY INTERFACES

Acquisition Activity	Warranty Interfaces
Engineering Development Models	Evaluate technology and performance for identifying key risk factors.
Preplanned Product Improvement (P^3I)	Couple warranty alternatives with any P^3I alternatives under consideration.
Functional Baseline	Refine essential performance requirements to be consistent with the functional baseline.
LCC Update	Establish/refine requirements for LCC analysis if LCC is part of warranty acquisition strategy.
Test and Evaluation Master Plan (TEMP)	Define any test requirements necessary to implement warranty.
Preliminary Manufacturing Plan	Address design and manufacture warranty requirements.
Industrial Base Issue	Address any potential impacts of warranty on industrial base.
Logistics Support Analysis	Update earlier analyses and define warranty alternatives that are consistent with planned ILS system.
Acquisition Plans	Update warranty acquisition plans.

- *Development of provisions*—Initial warranty provisions are developed on the basis of the information in Chapter Four. The program office should maintain continuous coordination with using commands and support activities.
- *Incorporation of provisions in FSD RFP*—After proper initial review with cognizant procurement, legal, and other interested parties, the initial warranty provisions are incorporated into the FSD RFP—primarily for informational purposes, unless a firm warranty commitment is to be made at this time. It may be necessary to prepare special instructions to the bidder to clarify selected points. Additional special briefings with potential contractors may be required to explain the intent of the provisions, since some contractors have had no experience or only limited experience with these concepts.
- *Development of final preliminary provisions*—As a result of the foregoing processes, changes in the initial provisions may be developed as necessary to clarify wording, changes in coverage, and other areas. In the case of a combined engineering development/production procurement, the final provisions become part of the contract, typically as an option that may be exercised at a later point in engineering development. If it is not a combined procurement, the provision may still undergo additional changes and evaluation as part of the production procurement.

5.4 FULL-SCALE DEVELOPMENT PHASE

The final products of the Full-Scale Development phase are product baseline configuration design and a documentation package that reflect the established cost, schedule, logistics supportability, and performance constraints. Table 5-5 lists major acquisition activities in this phase and identifies areas of interface with the development and implementation of warranty application.

During the FSD phase, better estimates of system reliability, maintenance and support parameters, and operating capabilities become available. Warranty applicability and economic studies can be refined and updated, and warranty provisions can also be updated to reflect program or equipment modifications that have occurred during FSD. Major warranty studies in this phase are summarized as follows:

- *Warranty feasibility studies*—The initial economic studies performed as part of the Development/Validation phase may be updated in light of FSD information. If previous studies were not performed, the studies may be initiated.
- *Development of final provisions*—If warranty provisions were not finalized as part of the Demonstration/Validation phase, provisions for the Production phase are formulated or refined, with proper coordination between program office and appropriate user and support activities.
- *Incorporation of provisions in production RFP*—Provisions are incorporated into the production RFP if they were not incorporated previously. Warranty issues to be addressed in the RFP include warranty management, facilities, in-plant material flow, data, and price. As previously noted, instructions to bidders regarding required response may be necessary.
- *Proposal review*—Production proposals must be evaluated with respect to warranty response. The degree to which the full intent of the provisions is adhered to, as well as quoted cost, is of concern. If a warranty price quotation was requested,

TABLE 5-5

FULL-SCALE DEVELOPMENT PHASE ACQUISITION ACTIVITIES AND WARRANTY INTERFACES

Acquisition Activity	Warranty Interfaces
Allocated Baseline	Define quantitative warranty requirements at appropriate subsystem levels.
System Prototype Tests	Evaluate data and use to perform warranty analyses, e.g., LCC and R&M.
Integrated Logistics Support	Address warranty implementation and administration.
Quality Assurance (QA) Plan	Identify approaches to implementing warranty controls on design and manufacture and defects in materials and workmanship.
LCC Update	Update LCC model for warranty cost-benefit analysis and refine data base.
TEMP Update	Identify/update any warranty test requirements.
Acquisition Plans	Interface with development and potential production contractors, draft warranty RFP clauses for industry review, and evaluate comments.

the economic analysis performed may be repeated, using the quoted warranty cost in lieu of the computed estimates. Any questionable points may be clarified in discussions held with contractors. Table 5-6 lists some factors to consider in evaluating warranty proposals. The applicability of the factors and the detail to which they are considered will depend on the extent of the warranty commitment and specific terms and conditions.

- *Warranty decisions*—On the basis of the economic analysis, as well as mission and logistics factors, the program manager must decide among available warranty options. The decision should be made early enough (ideally at the time of long-lead-item commitment) to permit orderly planning by all affected activities, regardless of the choice made. If a warranty is selected, provisions for funding and for warranty payments must be established.

TABLE 5-6

PROPOSAL EVALUATION FACTORS

Factor	Evaluation Criteria
Warranty Management - Pertains to the offeror's overall approach to managing the warranty program.	The organization or group responsible for managing the warranty should be clearly defined. It should be demonstrated that the organization can adequately perform the necessary interface between the warranty support group, engineering design, reliability and quality control groups, and higher-level management within the organization. The offeror's overall approach should demonstrate understanding of the general goal of the warranty as well as specific requirements.
Facilities and Equipment - Considers the existence, adequacy, and availability of resources necessary for warranty service.	The facilities planned for performing warranty services should be fully described and demonstrated to be suitable. Facilities include the primary repair facility, and storage, receiving, and shipping areas. The offeror should show that test equipment for processing warranty returns is adequate and available.
In-Plant Material Flow - Considers the offeror's proposed approach to processing returned equipment.	The procedures by which the offeror will receive, test, repair, modify, store, and ship the warranted equipment should be fully described and be consistent with the warranty terms and conditions. Specific attention should be given to the proposed methods for ascertaining warranty applicability on returned equipment and the offeror's understanding of the specific exclusions and definitions of unverified failures. It is desirable for the offeror to describe the time sequence of material flow, with rationale to show that a specified turnaround time will be achieved.
Warranty Data - Considers the capability of the offeror to comply with warranty data requirements.	The offeror's approach to developing and maintaining a data system should be capable of meeting warranty data collection and analysis requirements in a timely and complete manner. Specific attention should be directed toward critical parameters involving contractual commitment, such as turnaround time, operational MTBF, and equipment modification status.
Warranty Price/Reliability Compatibility - Considers the relationship between warranty price and proposed or guaranteed reliability levels.	The warranty price bid by an offeror should be consistent with stated reliability levels. Analysis of the relationship between those two factors, when allowed by the procurement approach, can prevent future problems resulting from too low or too high a price or failure to experience the field reliability expected.

Chapter Six
WARRANTY ADMINISTRATION

This chapter presents guidelines for administering a warranty, including activities necessary to prepare for the warranty, implement the warranty, conclude or extend the warranty, and assess the benefits.

Depending on the complexity of the warranty being applied, the procedures and interfaces needed for administering the warranty can vary considerably. Where program technical risks are low and a simple warranty is adequate, administration may be as simple as reviewing a checklist to ensure that the Government has no tasks to perform before fielding the weapon system, and performing a simple evaluation at the conclusion of the warranty. On the other hand, program risks may call for a more complex, incentive type of warranty that may require extensive Government activities to make it work. It is neither the intent of the warranty law nor the desire of the services to formulate a warranty that requires extraordinary actions to implement. In crafting the warranty, every effort should be made to keep the administrative tasks to a minimum. The best way to ensure that the warranty will be workable in the operational environment is to insist that knowledgeable user and logistics personnel participate in developing the warranty contractual provisions.

6.1 PREPARING FOR THE WARRANTY

For this section, it is assumed that warranty provisions are under contract and the weapon system development or production phase has begun. A prerequisite to preparing for the warranty is to read and thoroughly understand the warranty contract provisions. During the development or production phase of the weapon system certain activities may be required, depending on the type and complexity of the warranty. The following subsections identify tasks that may be required for some of the more complex incentive types of warranties. For the simpler types of warranties, these tasks may be used as a checklist to be sure that all activities have been considered. The military service should designate a warranty manager who will act as the focal point for warranty task performance.

6.1.1 Develop Item-Management Procedures

Some warranties may require the development of special procedures for the item manager or the system manager, such as the following:

- If the contractor performs repairs under the warranty, it may be desirable to use the contractor's repair facility as a stock point and develop procedures accordingly.
- Warranted assets to be used by more than one service may need to be kept separate as they move through supply channels to a common repair source.

6.1.2 Establish Plan for User Indoctrination

For some types of warranties, especially those requiring special handling of assets, or for assets that are classified, it may be desirable to prepare a training course or other means of indoctrination for personnel who manage or handle the assets.

6.1.3 Coordinate In-Plant Inspection Requirements

For warranties in which Government-owned assets will be handled or processed by a contractor, and in which the contractor's performance is to be measured by in-plant activities, it may be necessary to plan

for some additional inspections by DCAS representatives.

6.1.4 Review Contractor Data Plan

If the contractor is required to supply data for the purpose of implementing a warranty or evaluating the results of a warranty, it may be desirable to review the contractor's plan for collecting and using the data.

6.1.5 Perform ECP Reviews

Certain Government-directed design changes or contractor-proposed ECPs may abridge the effectiveness of a warranty. For both Government-initiated and contractor-initiated design change proposals, it will be important for the contractor to provide a warranty impact statement. If the contractor claims that a design change will result in increased warranty cost or abridgment of the warranty, such a claim should be supported with adequate engineering rationale.

6.1.6 Survey Contractor's Maintenance Facilities

If the warranty requires the contractor to perform maintenance on the warranted assets, the Government should conduct a survey of the maintenance facilities to be sure that the capacity is sufficient throughout the warranty period and that repair of production-line assets (belonging to the contractor) will not interfere with repair of warranted assets (belonging to the Government).

6.1.7 Develop or Review Required Test Plans

For some warranties, the contractor's performance or compliance may be determined by prescribed tests. The Government may be required to develop such test plans or, if the contractor develops the plan, to review it.

6.1.8 Develop User Data-Transmittal Methods

Data may be required from the deployed warranted system. The data may be needed to administer the warranty or to evaluate benefits at the conclusion of the warranty. Planning is required to ensure that the appropriate data are collected and sent to the warranty manager in time to meet project needs.

6.1.9 Review Warranty Markings and Seals

The Government should approve warranty markings and seals that may be required. If seals are required, they should be of a type that is not easily broken.

6.2 IMPLEMENTING AND ADMINISTERING THE WARRANTY

This section presents guidance for preparing a plan for administering the contractual warranty. The plan, called an implementation plan in this handbook, may also be referred to as an administration plan or, in the case of the Army, a warranty technical bulletin (WTB). The purpose of the implementation plan is to provide a complete and comprehensive document that describes the features of the warranty, defines the responsibilities for meeting the contractual provisions of the program, identifies the responsible participants, and establishes the procedures and interfaces required for successful implementation and management of the warranty.

All three services acknowledge the need for some form of warranty implementation plan, even though their plans differ slightly. For example, in Army Regulation 700-139 (Army Warranty Program Concepts and Policies), the materiel developer (MAT DEV) prepares a WTB as part of the materiel fielding plan (MFP). The materiel fielding team (MFT) then reviews the WTB requirements with the gaining MACOM during MFP negotiations. MACOMs have been directed to establish warranty control offices or officers (WARCOs) to coordinate all warranties within the MACOM.

There are two kinds of warranty implementation plans: those prepared by contractors and those prepared by the Government. Contractor plans are prepared in response to the contract requirements. The decision as to whether a contractor must submit a warranty implementation plan should be based on the criteria used to determine the need for a Government implementation plan. These criteria are discussed in Section 6.2.1.1. Since this handbook has been prepared as guidance for the Government, it addresses only the Government requirements for implementation plans.

Depending on the nature of a procurement, warranty contractual provisions may originate in a program office (for development-production procurements)

or an item manager or system manager's office (for many reprocurements or procurements not associated with a substantial development effort). In the former case, the crafters of the warranty are not necessarily the same people who will have to implement, administer, and evaluate it. In the latter case, the same office will probably develop and manage the warranty to its conclusion. Most warranty administration or implementation plans of record have been prepared by the same organization that prepared the warranty.

Figure 6-1 shows the three major considerations that must guide and constrain the implementation procedures and, therefore, the plan. Warranties range in complexity from the very simple to the more complex incentive warranties that may call for protracted contractor participation. If the contractor is required to perform warranty-related tasks for an extended period after the system is fielded, the implementation plan will likely need to include procedures that are workable within the supply-support system and the equipment's operating environment.

6.2.1 Responses to Commonly Asked Questions About the Implementation Plan

The following subsections address some of the questions most often asked regarding an implementation plan for warranties.

6.2.1.1 Under What Circumstances Is a Warranty Implementation Plan Required?

Some services may require an implementation plan irrespective of the simplicity or the technical needs of the warranty. From a technical viewpoint, the decision as to whether or not to prepare an implementation plan should be made by the drafters of the warranty contract provisions. They are most familiar with the responsibilities of the contractor and the Government, and they also must have knowledge of the supply-support system and deployment and operating factors. For simpler types of warranties that contain no requirements for contractor or Government actions to carry out the warranty provisions and require no evaluation of the effectiveness of the warranty, a plan may not be needed (these occasions are apt to be rare). On the other hand, complex, incentive types of warranties may need detailed implementation procedures, depending on how complex the contract provisions are. As the warranty provisions are being formulated, and while program logistics, engineering, and contracts representatives are reviewing the provisions, it will become clear whether or not a plan is required and how complex it will have to be. In general, some form of warranty implementation plan will be required if one or more of the following requirements apply:

- The warranty contract provisions require the Government to perform actions or tasks.
- The contractor is required to perform actions or tasks that will need Government monitoring, inspections, or reaction.
- The contractor is required to submit deliverables related to the warranty.
- There is a requirement to evaluate the effectiveness of the warranty.

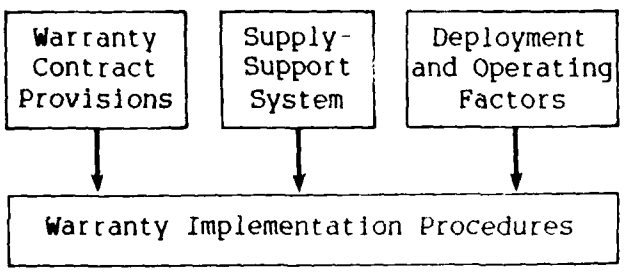

FIGURE 6-1
FACTORS THAT INFLUENCE WARRANTY IMPLEMENTATION PROCEDURES

6.2.1.2 Who Should Write the Implementation Plan?

The author of the warranty contract provisions should write the warranty implementation plan, with review provided by the warranty manager. This is especially true for warranties where the responsibilities and relationships between contractor and Government may be complex and may therefore need clear interpretation. If it is not possible for the author of the warranty contract provisions to also write the implementation plan, the plan should, as a minimum, be reviewed by the office that prepared the warranty contract.

Plan Preparation for Joint Service Weapon Systems

For weapon systems that are to be fielded by more than one service, it is customary to establish a lead service for the procurement. The other user services

may have representatives at the lead service program office and logistics office. In such cases, the warranty contractual provisions must be prepared under the joint constraints of all user services. Similarly, the implementation plan must be able to accommodate the constraints of all user services. In preparing the joint implementation plan, the service logistics representatives should ensure that the plan is workable within the constraints of their operation and support systems.

Plan Preparation for FMS Weapon Systems

If a foreign military customer is to participate in a warranty program, the same type of joint effort and coordination as described for joint service procurements should take place with the FMS customer.

6.2.1.3 When Should the Warranty Implementation Plan Be Written?

Preparation of the warranty implementation plan can begin after the warranty contract provisions have been written and reviewed by the procuring activity. The final plan is not prepared until the procurement contract is negotiated, since some of the warranty provisions may change in negotiations. The plan should be available to the system users in time to allow for any training that may be necessary.

6.2.1.4 What Should Be the Authority of the Implementation Plan, and Who Should Approve It?

The warranty implementation plan is an informational type of document from one military command to another. It is not a contractual document, and contractual-type language should be avoided. The most authoritative form that the plan might adopt is that of a Memorandum of Agreement (MOA) or Memorandum of Understanding (MOU) between the program or developing office and the user. The plan contains the minimum procedures that will make the warranty workable. It is therefore important that the weapon system users have an opportunity to help shape the plan.

The final plan should have endorsements from the developing office, the supporting command, and the user. It is important that the plan be reviewed by the contracting officer and a representative from the Judge Advocate General's (JAG) staff. The contracting officer needs to know how the plan will interface with the contract, and the JAG review will ensure that the plan does not introduce a legal problem between the Government and the contractor. It is also recommended that the weapon system contractor review the plan to see how the entire implementation fits into contractual obligations.

6.2.1.5 What Topics Should Be Covered in the Implementation Plan?

The scope of topics for the implementation plan will vary considerably with the nature and complexity of the warranty. Three items are needed to prepare the plan:

- A copy of the warranty contract provisions
- The topic checklist that appears in this handbook (Section 6.2.2)
- An understanding of the operating and support environment of the warranted weapon system

Every requirement in the warranty contract has to be deliberated in terms of how and by whom it is to be accomplished.

6.2.2 Checklist for Plan Preparation

Figure 6-2 is a checklist to help ensure that all applicable topics have been addressed in the plan. The checklist is not complete, but it should stimulate thought that will reveal other needed topics.

6.3 CONCLUDING OR EXTENDING THE INCENTIVE WARRANTY

Prior to the expiration of an extensive form of warranty, particularly one requiring contractor depot repair such as RIW, the Government must assess whether the warranty should be continued or allowed to expire. Extension options for warranty provisions are sometimes included in the original warranty contract, but such provisions are not necessary, since the Government and the contractor can enter into negotiations for contract extension at any time. If the original contract includes a fixed-price extension option, so much the better: Negotiations are eliminated, and the decision to exercise the option is simplified.

The decision to extend a warranty should be based on whether or not the perceived risks that originally spawned the need for a warranty have been diminished to an acceptable level; if they have not, a candid appraisal should be made of whether risks will be controlled by a continuation of the warranty. For some weapon system procurements, there may be no

Introductory Material

- ☐ Description of weapon system
- ☐ Description of warranties being applied
- ☐ Specific components of hardware or software to which warranty is applicable
- ☐ Hardware or software items that are specifically excluded from the warranty (e.g., preproduction or special test articles)
- ☐ Authority of the plan (office under whose direction the plan is to be administered, and the plan's authoritative precedence)
- ☐ Duration or period of effectivity of the plan
- ☐ Office sponsoring and maintaining the plan
- ☐ All organizations having responsibilities under the plan
- ☐ Applicable regulations and directives

Implementation Procedures

- ☐ Pre-warranty-period activities (e.g., develop contractor warranty plans, review contractor capacities, develop training, resolve ECP processing issues)
- ☐ Warranty-period events (e.g., achieve organic maintenance capability, conduct verification test, introduce second-source systems, transfer system ownership)
- ☐ Post-warranty-period activities (e.g., update configuration, transition to organic maintenance, assess warranty benefits)
- ☐ On-equipment (organizational-level) maintenance procedures; cite only exceptions to standard procedures
- ☐ Procedures for issue and receipt of warranty assets
- ☐ Off-equipment maintenance procedures (for intermediate, direct support, and general support levels); cite only exceptions to standard procedures
- ☐ Depot maintenance procedures; cite only exceptions to standard procedures
- ☐ Retest-okay (RTOK) processing
- ☐ Maintenance data requirements; cite only exceptions to standard requirements
- ☐ Other maintenance exceptions (e.g., FMS, special-use assets)
- ☐ Transportation procedures; cite only exceptions to standard procedures)
- ☐ Contractor data and reporting requirements
- ☐ Special packaging requirements
- ☐ Transportation and packaging funding
- ☐ Damage reporting
- ☐ Special storage requirements (resulting from warranty only)
- ☐ Commingling of warranted and nonwarranted assets
- ☐ Operation of contractor's secure storage area
- ☐ Considerations of stock-issue priorities
- ☐ Communications procedures for maintenance and utilization data; cite only exceptions to standard procedures
- ☐ Description of required contractor in-plant procedures
- ☐ Description of special DCAS responsibilities
- ☐ Custody-transfer requirements
- ☐ ECP processing procedures; cite only exceptions to standard procedures
- ☐ Configuration control procedures; cite only exceptions to standard procedures
- ☐ Warranty impacts on Technical Orders
- ☐ Warranty funding
- ☐ Funding for repair of exclusions

Management Responsibilities

- ☐ Warranty program manager
- ☐ Inventory manager
- ☐ Procurement responsibility
- ☐ Configuration management
- ☐ Supply management
- ☐ Data management
- ☐ FMS management
- ☐ Training responsibilities
- ☐ Contract administrator
- ☐ Prime contractor's management responsibilities

Contractual Relationships

- ☐ Related contracts and their relation to the warranty contract provisions (e.g., interim contractor support contracts, CSPAs, and collateral contracts for repair of exclusions)

FIGURE 6-2

CHECKLIST OF TOPICS FOR WARRANTY IMPLEMENTATION PLAN

perception of risk in any area to which a warranty would pertain. Application of a warranty to such procurements satisfies the law and is probably a no-cost, or at least a low-cost, assurance type of warranty. If the perception of no risk is substantiated during the warranty period, the warranty should be allowed to expire. "Transition" out of such warranties may consist of nothing more than a letter of acknowledgment from the contractor that the warranty has expired and contractor obligations under it are ended. At that time, the Government's warranty manager should undertake an evaluation of the benefits that resulted from the warranty. For the more complex warranties – those under which the contractor has had to become part of the support system – the decision to extend a warranty may hinge on more than a projection of economic benefits.

Some of the noneconomic factors that may influence the decision to extend a warranty include the following:

- Status of organic support capability
  - Test equipment (hardware and software)
  - Technical documentation
  - Maintenance training
  - Facilities
  - Personnel
  - Adequate spares (of particular concern is the transition from a relatively short contractor repair turnaround time to the conventional organic time that may be as long as 90 to 120 days, inducing a need for many more spares to maintain readiness levels)
- Configuration status of warranted assets
- Special repair procedures that may have been developed by the contractor
- Impacts on other services and FMS customers
- Need and ability for gradual transition
- Contractor's performance

In the event that any of these factors precludes a transition from contractor to organic support, it may be prudent to discontinue the contractor's warranty obligations and risk and provide for continued contractor support under separate contract arrangements. This may be facilitated under a contract that is already in place as a vehicle for paying the contractor for repair of excluded failures.

6.4 ASSESSING THE BENEFITS OF THE WARRANTY

There is one inherent difficulty in assessing quantitative benefits of a warranty: Certain observed parameters of a weapon system have to be compared with what they might have been without a warranty. It is impossible to avoid some conjecture under these conditions. Nevertheless, if many unbiased analyses show that systems with warranties have benefits over systems without warranties, the analyses will have served their purpose. It is important that analysis results be accumulated at a central point so that a global assessment can be made; the PPAC at Wright-Patterson Air Force Base has this function. An assessment of warranty benefits should be considered for the following five areas:

- The warranty's influence on the essential performance parameter(s)
- The economic impact of the warranty on the Government and the contractor(s)
- Noneconomic benefits of the warranty
- The workability of the warranty (e.g., ease of implementation)
- Contractor motivations and actions under the warranty

Achievement of the essential performance requirements does not necessarily mean that they would not have been met without the warranty, nor does failure to achieve the performance requirements necessarily mean that the warranty was ineffective. If a warranty produces a high level of contractor motivation but unsurmountable technical problems preclude achieving the required performance parameters, the warranty might still be termed a success. (The problem in this case lies in failing to recognize the gap between the requirement and the technology status. That is a fault of the specification.)

One approach to assessing the warranty's influence on the essential performance parameters is to compare achievements under the warranty with past achievements (without warranty) of the same parameter. Factors that should be used as "normalizing" factors in comparative analysis include absolute values of comparative parameters, whether the same contract is used in the comparison, the competitive environment, and the general level of the technology for the comparative cases.

Economic analyses should be attempted. For some warranties, there will be no recognizable costs. For example, there may be no costs associated with an assurance type of warranty on a proven item that requires no contractor actions if the warranty provisions are satisfied. Any cost risks that the contractor believes must be covered could be buried in the hardware price. An economic analysis of such a war-

ranty is difficult. For warranties with identifiable associated costs, the economic analysis should be a refinement and verification of the cost-benefit analysis that was performed before the warranty was contracted. (Cost-benefit analysis is discussed in Chapter Seven.)

An assessment of the workability of the warranty will be subjective. It should consist of an evaluation of how successful the warranty implementation was. Any implementation difficulties should be recorded and, if possible, turned into lessons learned for the PPAC data base.

Insights into a contractor's motivation should be gained through its deeds. Many contractors will freely discuss steps they may have taken to reduce their risks under the warranty.

The assessment of warranty benefits should be documented and a copy forwarded to the appropriate warranty focal point. Periodic evaluations by these focal points will provide invaluable insights into how warranties and their implementation can be made more effective.

Chapter Seven
WARRANTY COST-BENEFIT ANALYSIS

This chapter describes methods for evaluating the economic implications of the use of warranties under 10 USC 2403. The chapter discusses requirements for and approaches to conducting warranty cost-benefit analyses to determine whether use of a warranty would be cost-effective, presents discussions of warranty cost elements and warranty benefits, and summarizes available DoD models to aid in performing cost-benefit analyses.

7.1 REQUIREMENTS FOR COST-BENEFIT ANALYSES

Cost-benefit analyses are required for warranties under 10 USC 2403. The following subsections summarize Congressional, DoD, and service policy and guidance for conducting the analyses.

7.1.1 Conference Report of the 1985 DoD Authorization Act

In enacting the current warranty requirements of 10 USC 2403, the conference report of the 1985 *DoD Authorization Act* expressed strong concern regarding the issue of warranty cost-effectiveness. It questioned the fact that virtually no waivers were processed in 1984 under the original warranty bill (Section 794) and added that the Senate and House Committees on Armed Services have never intended that warranties that are not cost-effective should be obtained. As a result of this concern, the conference report directed each of the military departments to establish mechanisms for effective cost-benefit analysis of proposed weapon system guarantees.

7.1.2 DFARS Subpart 46.7

DFARS Subpart 46.7 includes a number of subsections providing guidance for the services for implementing the warranty requirements of 10 USC 2403 in the acquisition of weapon systems.

As presented in DFARS Subsection 46.770-8, it is DoD policy to obtain only cost-effective warranties under 10 USC 2403. If a specific warranty is considered not to be cost-effective by the contracting officer, a waiver request is initiated following procedures described under DFARS Subsection 46.770-9. To determine whether use of a warranty would be cost-effective, an analysis must be performed, comparing the benefits to be derived from the warranty with acquisition and administration costs. The analysis should examine a weapon system's life-cycle costs with and without a warranty. Where possible, a comparison should be made with the costs of obtaining and enforcing similar warranties on similar systems. The analysis should be documented in the contract file.

7.1.3 Service Policies

Currently, the services are in the process of developing and providing additional guidance and detailed instructions for the full implementation of DFARS Subpart 46.7. These developments are expected to include the conduct of warranty cost-benefit analyses.

7.1.3.1 Navy

Secretary of the Navy Instructions (proposed SECNAVINST 4330.xx) are currently being developed and reviewed that include additional guidelines to DFARS Subsection 46.770-8 for the conduct of warranty cost-benefit analyses in Navy programs. Specifically, additional guidance is provided on selection of the warranty type, performance of a life-cycle cost-benefit analysis, performance of risk and qualitative analyses, and documentation of pro-

cedures and results. The conduct of warranty cost-benefit analyses will continue to adhere to the policy and guidelines established for cost-benefit and life-cycle-cost analyses in Economic Analysis Program Evaluation for Navy Resource Management, SECNAVINST 7000.14B, 18 June 1975. The Navy has recently sponsored several research studies in the area of warranty cost-benefit analysis procedures (References 8 and 16).

7.1.3.2 Army

On 23 September 1985, the Office of the Assistant Secretary of the Army (Acquisition) issued additional warranty policy guidance to DFARS Subsection 46.770-8 concerning remedies and cost-benefit analyses in Army programs (Reference 17). The guidance is summarized as follows:

- Contracts for acquisition of weapon systems will not exclude the requirements to redesign potentially defective parts. The redesign responsibility is viewed as the most effective remedy available to achieve the required performance requirements.
- A formal cost-benefit analysis must be completed and documented in the contract file for every warranty. This corrects a possible misconception that such an analysis is required only if a decision is made to request a waiver.

To assist contracting officers in completing cost-benefit analyses before negotiating an agreement on a warranty price, the Army has made available a warranty cost-effectiveness model named WARM developed by the Army Aviation Systems Command. The model is discussed in Section 7.7.

7.1.3.3 Air Force

The Air Force, in a guidance document entitled *United States Air Force Warranty Administration Plan*, 11 April 1986, strongly advocates a team approach to warranty strategy led by management and composed of engineering, logistics, budget, contracting, legal, competition advocate, and user personnel. The document specifically requires that cost-benefit analyses be conducted. The use of warranties (PPAs) that are determined to be cost-effective or in the interest of national defense is also recommended, regardless of the unit or total production cost.

The Air Force Product Performance Agreement Center at Wright-Patterson Air Force Base is the technical focal point for warranty application. It offers a number of tools to aid in selecting an appropriate warranty form and in performing cost-benefit analyses. The PPAC model is addressed in Section 7.7.2.

7.2 COST-BENEFIT ANALYSIS PROCEDURES

The following subsections discuss procedures related to conducting a cost-benefit analysis for determining the cost-effectiveness of a warranty and review the specific ground rules in DFARS Subpart 46.7 for conducting warranty cost-benefit analyses.

7.2.1 Framework of Analysis

This section presents a simple framework for conducting a warranty cost-benefit analysis; the framework, summarized in Figure 7-1, is based on a life-cycle-cost principle as suggested in DFARS 46.7.

Let us first define several terms as follows:

LCC = life-cycle costs—the costs to acquire and operate a system over its lifetime*

LCC_{NW} = life-cycle costs without a warranty

LCC_W = life-cycle costs with a warranty

We can now define the warranty cost-benefit (WCB) as follows:

$$WCB = LCC_{NW} - LCC_W \quad (1)$$

If LCC is the only decision metric, then WCB must be positive (or at least not negative) for the warranty to be cost-effective. By considering one more level of detail for LCC_W, we can establish a basis for evaluating warranty price. For this level we define

$$LCC_W = WP + LCC_{\overline{WP}} \quad (2)$$

where

WP = price for the warranty

$LCC_{\overline{WP}}$ = all other LCC costs exclusive of warranty price

*To avoid complications for this elementary presentation, we ignore the time value of money and inflation factors. Normally, these will have to be introduced in an appropriate manner to provide a firm basis for analysis.

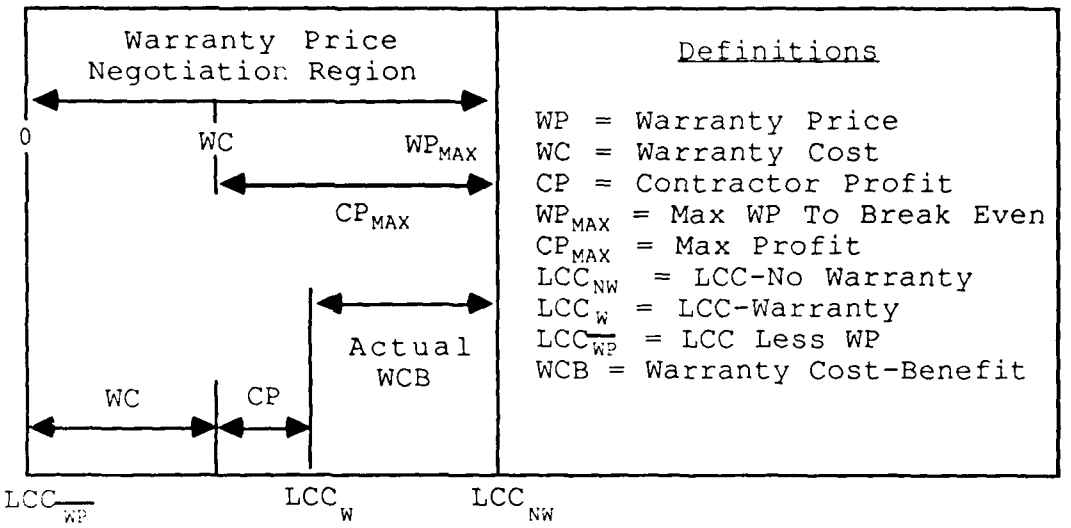

FIGURE 7-1
WARRANTY COST-BENEFIT FRAMEWORK

Combining equations 1 and 2, we have

$$WCB = LCC_{NW} - LCC_W$$

$$= LCC_{NW} - WP - LCC_{\overline{WP}} \quad (3)$$

Since a value of WCB = 0 is the break-even point for selecting a warranty, the maximum price to pay is given by

$$WP_{max} = LCC_{NW} - LCC_{\overline{WP}} \quad (4)$$

Now let us assume that the cost to the contractor for supplying the warranty is estimated to be WC. Then we have

$$WP = WC + CP \quad (5)$$

where

$$CP = \text{contractor profit}$$

From equations 4 and 5, the contractor's maximum profit is

$$CP_{max} = WP_{max} - WC$$

$$= LCC_{NW} - LCC_{\overline{WP}} - WC \quad (6)$$

These relationships are shown graphically in Figure 7-1. If LCC_{WP} and LCC_{NW} are calculated, the region between the $LCC_{\overline{WP}}$ and LCC_{NW} values represents the range of possible values to negotiate a warranty price that will still lead to a positive cost-benefit. The figure shows, for an assumed value of WC, the potential contractor profit region and the warranty cost-benefit region for a selected profit level.

7.2.2 Performance of Analysis

DFARS Subpart 46.7 provides specific ground rules for the conduct of warranty cost-benefit analysis, including tailoring warranty terms and conditions for cost-effectiveness; examining a system's life-cycle costs, both with and without a warranty; and documenting analysis results in contract files. These areas are discussed in the following subsections.

7.2.2.1 Tailoring Warranty Terms and Conditions

DFARS Subsection 46.770-3 permits contracting officers broad latitude in the construction of warranties, recognizing that the objectives and circumstances vary considerably among weapon system acquisition programs. Consequently, contracting officers can tailor required warranties on a case-by-case basis, including remedies, exclusions, limitations, and duration, so long as they are consistent with DFARS Subsection 46.770-3. It must be kept in mind that contracting officers can exercise these options, as appropriate, to derive cost-effective warranties in light of the technical risk, contractor financial risk, or

other program uncertainties. Contracting officers are encouraged to construct broader and more comprehensive warranties, or to narrow the scope of a warranty while it is advantageous to do so and is in accordance with agency policy. For example, not all essential performance requirements may be included in a warranty if the contractor was not responsible for the design of a system.

7.2.2.2 Factors Affecting Analysis Techniques

It is necessary to recognize that the techniques and methods used to conduct a cost-benefit analysis of a warranty may vary, depending on the following factors:

- Type of warranty selected
- Type of weapon system
- Terms and conditions exercised by the contracting officer (remedies, exclusions, limitations, duration, financial and technical risk, and uncertainty)
- Essential performance characteristics of a weapon system and their measurability (the extent to which they can be quantified, such as MTBF and other statistical measures of reliability)
- Identification and measurability of various types of costs (acquisition, and administrative and enforcement costs)

7.2.2.3 Examining a System's Life-Cycle Costs

DFARS Subsection 46.770-8 suggests that benefits to be derived from the warranty should be compared with warranty acquisition and administration costs. The analysis should examine the expected life-cycle costs for the warranty versus the cost expected to be incurred if the weapon system were supported under normal organic support conditions or possibly contractor support services. If the contracting officer considers a specific warranty not to be cost-effective, a waiver request should be initiated under DFARS Subsection 46.770-9. The service cost models reviewed in Section 7.7 use a life-cycle-cost perspective.

7.2.2.4 Documenting Analysis Results

DFARS Subsections 46.770-8 and 46.770-9 require that warranty cost-benefit analyses be documented and made part of the contract file. The documentation should explicitly present the methodology and approach used in estimating costs and benefits over the life of the weapon system. In addition, data sources should be identified. The documentation should be sufficiently complete that another analyst could implement the approach taken and, with the same data, reproduce the results to verify the technical soundness of the analysis.

7.3 A GENERALIZED APPROACH TO WARRANTY COST-BENEFIT ANALYSIS

This section presents a generalized approach to conducting a warranty cost-benefit analysis, using the analysis framework presented in Section 7.2 and following the DFARS guidance in employing a life-cycle-cost approach. The approach assumes that for any given procurement there may be several forms of warranty to consider, and for any given form there may be a number of possible variations. For example, for a simple assurance type of warranty, the duration of the warranty is a decision variable. For an incentive form of warranty, a choice between an MTBF guarantee or an RIW may have to be made. Thus, a complete warranty cost-benefit analysis must consider a number of feasible alternatives. For each alternative, the warranty cost-benefit (WCB) must be estimated and that alternative which maximizes WCB selected.

Figure 7-2 is a form of decision tree that depicts the general approach to warranty cost-benefit analysis. Steps to be performed are numbered in the figure and summarized in Table 7-1. The approach is based on the assumption that the warranty price will be negotiated after the potential warranty cost-benefit is determined. Often the contractor's perception of warranty costs and risks is different from that of the Government. For this reason, Figure 7-2 shows a dashed line back from step 12 to step 11 to indicate that warranty form and parameter selection may be an iterative process during the price negotiation. Further discussion of the process is provided in the following section.

7.4 A SIMPLIFIED WARRANTY PRICE-ANALYSIS PROCEDURE

This section presents a simplified procedure for analyzing warranty price that can be used in a cost-benefit analysis, with appropriate modifications or extensions. The procedure is based on the assumption that failures that occur during the warranty will be the responsibility of the contractor—either through contractor repair or bill-back. Therefore, the analysis is one of comparing savings in repair costs with warranty price. The steps are as follows:

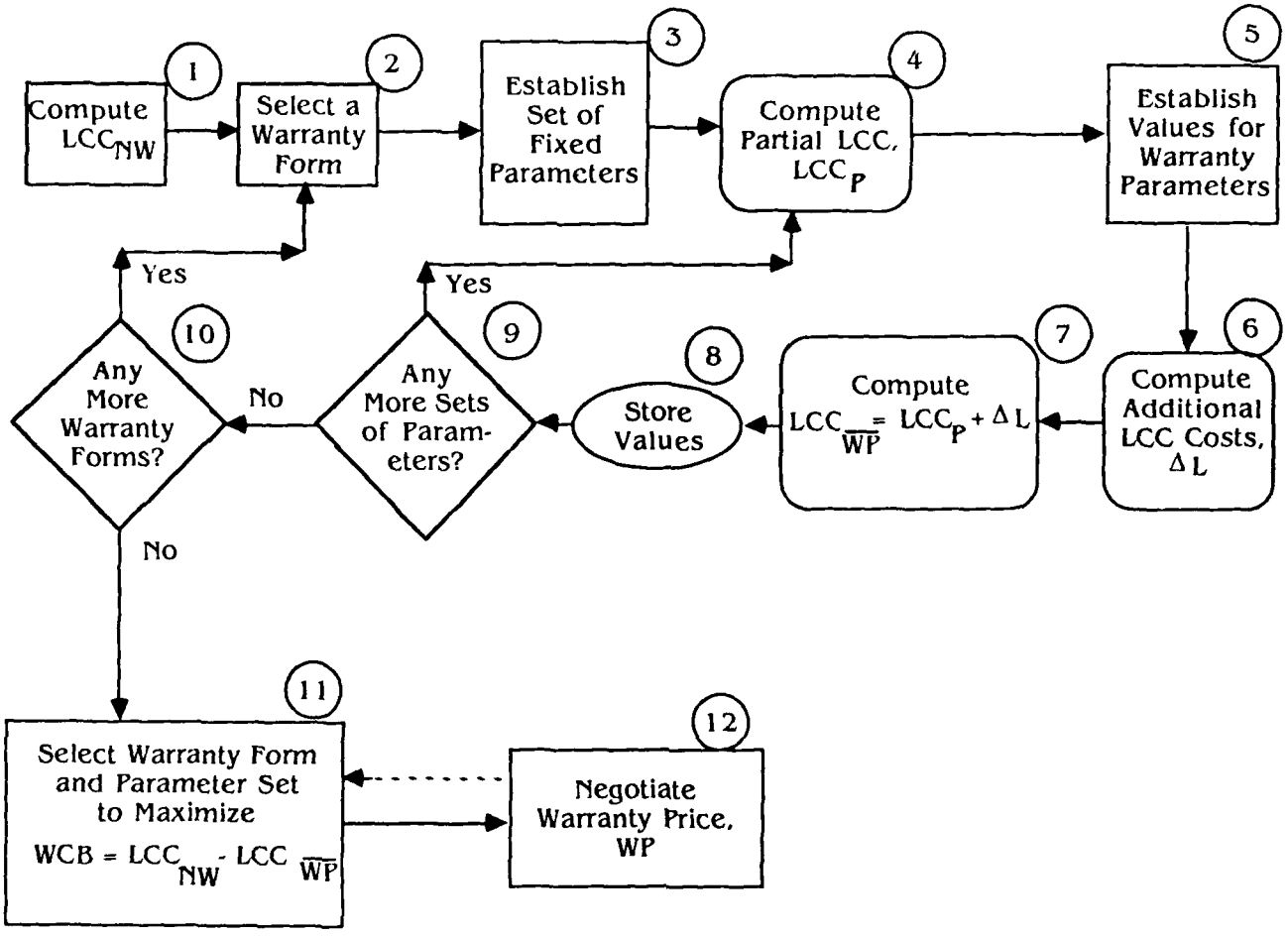

FIGURE 7-2
WARRANTY COST-BENEFIT ALGORITHM

- *Step 1* – Calculate the expected system usage (SU) over the warranty period, using operating hours, cycles, miles, or other appropriate units.
- *Step 2* – Estimate the average mean time between failures (MTBF) over the warranty period, using mean hours, mean cycles, mean miles, or other appropriate units.
- *Step 3* – Calculate the expected number of failures (EF) from the equation

$$EF = \frac{SU}{MTBF}$$

- *Step 4* – Estimate the cost to the Government to process each failure without a warranty (FC_{NW}).
- *Step 5* – Estimate the cost to the Government to process each failure under the warranty (FC_W) such as organizational maintenance, data, and shipping costs.
- *Step 6* – Estimate all other costs (OC) to the Government that are expected as a result of the warranty, excluding warranty price. This category primarily includes warranty administration costs and could include transition costs.
- *Step 7* – Estimate all other costs that will be saved (SC) through having the warranty, such as deferred purchase of test equipment and deferred training. Do not include the direct cost to process and repair failures.
- *Step 8* – Calculate the break-even price (WP_{BE}) for a warranty as follows:

$$WP_{BE} = EF \times (FC_{NW} - FC_W) + SC - OC$$

For a price of WP_{BE}, the expected costs to the Government are the same with and without a warranty. The following paragraphs illustrate this approach, using an example scenario.

TABLE 7-1

WARRANTY COST-BENEFIT DECISION STEPS

Step	Task	Description
1	Compute LCC_{NW}	For a selected life-cycle period, compute all costs associated with acquiring and operating the system, assuming that no warranty is to be included in the contract.
2	Select a Warranty Form	Considering factors related to the system, acquisition environment, and program objectives, select a candidate form of warranty.
3	Establish Set of Fixed Parameters	Select values to use in the LCC analysis that are independent of the warranty terms and conditions, e.g., military labor rates for maintenance.
4	Compute Partial LCC	Compute the life-cycle costs that do not vary with the warranty terms and conditions.
5	Establish Values for Warranty Parameters	Select a set of specific warranty terms and establish values to be used in the LCC calculation.
6	Compute Additional LCC Costs	Compute the remaining LCC values related to the warranty implementation.
7	Compute Total LCC Exclusive of Warranty Price	Add the values obtained in steps 4 and 6.
8	Store Parameter Set and LCC Value	Store values to be used for final selection.
9	Select Additional Parameter Sets	Vary applicable warranty parameters and repeat steps 4 through 8.
10	Select Additional Warranty Forms	Select another feasible warranty form and repeat steps 3 through 9.
11	Select Warranty Form and Parameter Set	Compute warranty cost-benefit for each alternative and select that which maximizes benefit prior to warranty price.
12	Negotiate Warranty Price	Using previous results, establish a fair warranty price, iterating as necessary.

Let us assume that a unit being considered for warranty has an expected MTBF of 1,000 hours. Five hundred such units are to be purchased and will operate an average of 50 hours per month. Government cost to process each failure without a warranty is estimated to be $1,200. A warranty of 18 months is being considered, under which the contractor will repair all covered failures. With such a warranty, the Government estimates it will cost $300 per failure and $75,000 to administer the warranty, and it will save $100,000 in deferred training and deferred purchase of depot test equipment.

The steps to be performed are as follows:

- *Step 1*—The expected system usage is

$$\begin{aligned} SU &= 500 \text{ units} \times 50 \text{ hours per month} \times 18 \text{ months} \\ &= 450{,}000 \text{ hours} \end{aligned}$$

- *Step 2*—The average MTBF over the 18-month period is 1,000 hours. Hence,

$$MTBF = 1{,}000 \text{ hours}$$

- *Step 3*—The expected number of failures is

$$\begin{aligned} EF &= SU/MTBF \\ &= 450{,}000/1{,}000 \\ &= 450 \end{aligned}$$

- *Step 4*—The cost to the Government to process each failure without a warranty is given as $1,200. Hence,

$$FC_{NW} = \$1{,}200$$

- *Step 5*—The cost to the Government to process each failure under the warranty is given as $300. Hence,

$$FC_{W} = \$300$$

- *Step 6*—Other costs related to the warranty that are expected to be incurred are given as $75,000. Hence,

$$OC = \$75{,}000$$

- *Step 7*—Savings due to the warranty are given as

$$SC = \$100{,}000$$

- *Step 8*—The break-even warranty price is then

$$\begin{aligned} WP_{BE} &= EF \times (FC_{NW} - FC_{W}) + SC - OC \\ &= 450 \times (1{,}200 - 300) \\ &\quad + 100{,}000 - 75{,}000 \\ &= \$430{,}000 \end{aligned}$$

These calculations show that if the price for the warranty is $430,000 or less, there is a net saving to the Government as a result of purchasing the warranty. A procedure of this type is somewhat simplistic; however, it does provide an initial indication of the potential cost-benefit to be gained by a warranty. Specific limitations are as follows:

- The procedure does not directly consider the time value of money. If the warranty price is paid with unit delivery, but the savings will occur in the future, appropriate discounting procedures should be employed.
- A conservative assumption is made that the MTBF is the same with or without a warranty. Generally, for warranties with incentive features, MTBF is expected to be better with a warranty because of the inherent motivation provided to the contractor to retain warranty dollars as profit.
- The required estimates for usage time, processing costs, and other costs are shown as single values but may require complex procedures and a relevant data base to obtain good estimates.
- The less-tangible benefits and disadvantages of a warranty are not considered (they are discussed in Section 7.6). For example, a warranty provides protection against paying for correcting a systemic problem that may require redesign. It may also cause some loss of self-sufficiency if the contractor is the only source of depot repair.

The simplicity of the procedure provides a convenient way of evaluating the sensitivity of the warranty price to one or more parameters. Figure 7-3 shows the break-even price as MTBF varies from 500 hours to 1,500 hours for the above example.

7.5 WARRANTY COST ELEMENTS

There are numerous Government costs that can be considered in warranty cost-benefit analysis. To evaluate the cost-effectiveness of a warranty accurately, it is necessary to identify and consider applicable cost elements that could have a major impact on system life-cycle cost. These cost elements may be obtained for both the no-warranty and warranty cases, or, equivalently, only incremental costs may be considered. The following subsections provide examples of such cost elements—direct and indirect—in the application of warranties.

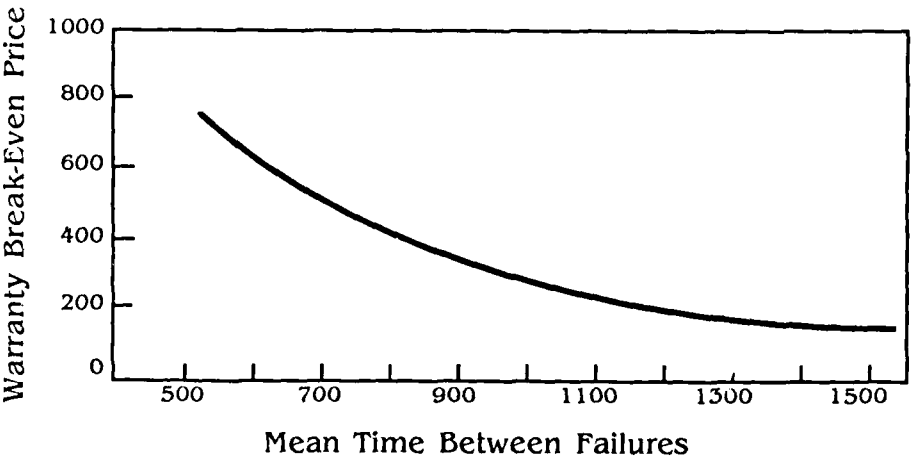

FIGURE 7-3
WARRANTY BREAK-EVEN PRICE VERSUS MTBF

7.5.1 Direct Cost Elements

Table 7-2 lists various cost elements that are useful in analyzing the cost-effectiveness of warranties from a life-cycle-cost perspective. Each cost element is defined and discussed in the following subsections, primarily for the warranty case.

7.5.1.1 Warranty Price

The warranty price cost element includes the price paid to the contractor for supplying the warranty and associated data products. The contractor can be expected to include in the price the costs of resources required to meet obligations under the warranty provisions in the contract. These costs may be augmented by profit and perhaps risk factors representing future warranty liability to determine the final warranty price.

In evaluating a contractor's proposed warranty price, consideration must be given to the following two public laws: P.L. 87-653, Cost and Pricing Data Requirements, and P.L. 91-379, Cost Accounting Standards. Under the disclosure requirements of P.L. 87-653, the contractor is responsible for substantiating the proposal with current, accurate, and complete cost and pricing data. This requirement extends to the warranty price as well as to all other elements of the proposal. The requirements of P.L. 91-379 also need to be considered. Any question as to whether the proposal as presented properly complies with the contractor's disclosure statement and approved accounting procedures should be pursued with the contractor and, if necessary, the contract administration office, to ensure compliance.

7.5.1.2 Warranty Development

The warranty development cost element includes the Government program development and management costs for obtaining cost-effective warranties in weapon system procurements. These costs may include the following activities:

- Strategy planning between contracts, engineering, and logistics personnel to decide on "essential performance requirements" and to tailor warranties on a system-by-system basis
- Cost-benefit analyses to determine whether the use of a warranty would be cost-effective
- Negotiation with contractors to determine the warranty language

Development of data bases and models from various past warranties of similar systems may also be required to aid in warranty performance and cost trade-off decisions.

7.5.1.3 Equipment Maintenance

The equipment maintenance cost element includes the labor, material, and transportation costs incurred by the Government for all preventive and corrective maintenance not performed by the contractor under the warranty. Preventive maintenance may include a resident staff that performs periodic maintenance, as well as a traveling staff that performs any special

TABLE 7-2

DIRECT GOVERNMENT WARRANTY COST ELEMENTS

Cost Element	Definition
Warranty Price	Cost of warranty charged by the contractor
Warranty Development	Cost of developing warranty terms and conditions
Equipment Maintenance	Cost of preventive and corrective maintenance
Redesign	Cost of engineering and modification of defective parts
Test Equipment	Cost of test equipment required to support the operating equipment
Test Equipment Support	Cost of operation and maintenance of test equipment
Initial/Replenishment Spares	Cost of spare units/modules for base and depot stock
Training	Cost of training personnel in the maintenance support and handling of the equipment and test equipment
Data	Cost of documentation for operation, maintenance, and support of equipment and test equipment
Inventory Management	Cost of inventory management functions for the equipment
Administration and Enforcement	Cost of procedures and staff to administer and enforce the warranty

maintenance on a periodic basis. Corrective maintenance may consist of organizational, intermediate, or depot maintenance costs. For military maintenance, the costs may include:

- Labor and material for fault verification and module replacement
- Shipping and depot labor and material for units that are not repairable at the station
- Shipping and depot labor and material for repairable modules
- Replacement costs for condemned repairable modules

For warranty, the costs may include:

- Fault-verification labor costs and incidental materials
- Cost of shipping units to and from the contractor if the Government pays for shipping

7.5.1.4 Redesign

The redesign cost element includes the labor and material costs of redesign and retrofit efforts that would be required for the system and component parts to conform to specified essential performance requirements. These costs may include:

- Engineering analysis to determine causes of nonconforming units
- Corrective engineering design and drawing changes
- Modification of units, spare units, or spare parts as required
- Activities associated with retest, retrofit, and configuration management

Normally, if a redesign is required, the bulk of these costs will be borne by the contractor under the terms of a warranty, with limitations or "caps" as specified in the contract. Without a warranty, these costs are borne by the Government.

7.5.1.5 Test Equipment

The test equipment cost element includes the cost of test equipment required to support the operating equipment. If the warranty includes contractor depot repair of all failures, more complex test equipment will be required for the no-warranty case than for warranty. However, at transition from warranty to organic repair, additional test equipment will be required, such as that needed at the depot level.

7.5.1.6 Test Equipment Support

The test equipment support cost element includes test equipment operation and maintenance cost.

7.5.1.7 Initial/Replenishment Spares

The initial/replenishment spares cost element includes the material costs of spare units and modules to support the various pipelines. In the event the system reliability fails to meet stated levels during the warranty coverage, additional spares may be required to relieve pipeline shortages that may develop.

7.5.1.8 Training

The training cost element includes cost of training personnel to operate, support, and maintain the equipment. It also includes training for warranted equipment, handling, and support, as well as training at transition from warranty to organic maintenance.

7.5.1.9 Data

The data cost element includes the cost to purchase data associated with the operation, maintenance, and support of equipment and test equipment. Depending on the warranty form, the Government may incur additional costs of purchasing data not previously supplied.

Warranty performance data may also be required, including the labor, computer, and material costs of developing and maintaining a data system to meet warranty data collection and analysis requirements. These efforts may include the following:

- A data collection and analysis program that will accumulate, process, analyze, and report the information required under the warranty
- A semiannual warranty data report containing records relating to population size, configuration, and repair history
- For the more extensive forms of warranty, an annual warranty effectiveness study containing warranty experiences and conclusions regarding the effectiveness of the warranty concept applied to the contract

In addition, it will be necessary to update any affected data, including drawings and technical documents, to reflect redesign and modification changes on failed items.

7.5.1.10 Inventory Management

The inventory management cost element includes the costs to the Government of managing items in inventory. Only those items (parts, modules, units) which are unique to the equipment are included. For a warranty where the lowest level of military maintenance is at the unit or module level, there will be many fewer unique items than for organic maintenance, where depot repair will require management down to the part or assembly level.

7.5.1.11 Administration and Enforcement

The administration and enforcement cost element includes the labor and material costs for Government personnel to manage the warranty. The necessary warranty functions to be performed include liaison between the program, support, user, and contractor activities, including development and implementation of procedures for the following:

- Reporting and processing warranty claims
- Handling, storing, and transporting warranted items
- Managing integrated logistics support and configuration management of warranted items
- Determining warranty compensation

This cost element is typically treated as a "delta" or incremental cost, as compared with the no-warranty case.

7.5.2 Indirect Cost Elements

The influence of many of the direct warranty cost elements (Table 7-2) on system life-cycle cost to the Government can be determined through cost modeling. Data may be available in many cases for obtaining parametric estimates. However, there are other warranty cost elements that are less amenable to modeling but could have a major influence on system life-cycle cost. These cost elements are considered to be indirect.

Table 7-3 lists various indirect cost elements that should be evaluated in warranty cost-benefit analyses. Because the elements represent risks and variabilities that cannot easily be accounted for, especially without a large data base, it may be necessary to apply engineering judgment when evaluating their influence on system life-cycle cost. This is particularly true for evaluating a contractor's proposal that may, in one form or another, include costs to protect against perceived risks.

The following subsections discuss the indirect cost elements.

7.5.2.1 Competition

A reduction in competition may result if warranty requirements, primarily essential performance requirements, present a high financial risk. The potential liability for system failures would be too great for some contractors to assume, and they would withdraw from competition rather than face the risk of serious financial loss. Their actions could reduce competition in the procurement process and result in higher system acquisition costs for the Government. Competition for follow-on production may also be reduced if the contractor, under warranty, has an established repair facility that has been amortized to an extent that would make it difficult for a new entrant to compete.

A further reduction in competition, leading possibly to increased cost, may occur if parts to maintain the system have to be procured from the contractor supplying the warranty. Usage of parts from other sources could void the warranty coverage if the terms and conditions are not carefully constructed.

7.5.2.2 Breakout

A decreased opportunity for breakout, leading possibly to increased cost, may occur as a result of warranty application. In the past, system programs

TABLE 7-3

INDIRECT GOVERNMENT WARRANTY COST ELEMENTS

Cost Element	Definition
Competition	Cost of reduced opportunities for competing future acquisition of equipment and parts
Breakout	Cost of reduced opportunities for future breakout acquisition of subassemblies
Warranty Default	Cost in the event the contractor fails to fulfill its warranty obligations
Technology	Cost of reduced opportunities for technological advances
Readiness	Cost of loss of readiness and failed maintenance capabilities in combat environment

have obtained significant cost savings by procuring directly and providing selected "broken out" assemblies to the system contractor as GFE. With warranties, however, system programs may find that the practice of breakout causes very difficult problems in resolving system failures, e.g., fault isolation, responsibility, and liability. Warranties may significantly reduce the amount of breakout and subsequent cost savings to the Government unless this issue is directly addressed in the contract to avoid such limitations.

7.5.2.3 Warranty Default

Warranty obligations may not be fulfilled for reasons such as litigation on liability for system failures, or severe monetary losses by the contractor. Consequently, the Government may have to face the risk of correcting system failures without compensation. The costs to the Government in this regard could be significant.

7.5.2.4 Technology

Use of advanced technologies in system design may decrease if contractors are motivated by warranties to use proven concepts to reduce the risk of future system failures.

7.5.2.5 Readiness

Warranties may affect readiness. For example, the need for contractor field services or return factory shipment could delay the repair of inoperable systems under warranty in the field, decreasing system readiness. Therefore, the impact on system life-cycle cost to maintain readiness should be evaluated in warranty cost-benefit analyses. One solution may be to have additional spare units available in the field or supply pipelines to decrease system downtime. The acquisition and support costs of such additional spares should then be evaluated in the cost-benefit analyses.

7.5.3 Cost Factors

Numerous cost factors can be used to estimate the direct and indirect warranty cost elements listed in Tables 7-2 and 7-3. To accurately evaluate the cost-effectiveness of a warranty pursuant to the requirements of DFARS Subsection 46.770-8, it is necessary to identify and consider cost factors that could have a major impact on the system life-cycle cost.

Air Force warranty guidelines (Reference 3) present concepts for the development and application of warranties in the acquisition of weapon systems. The guidelines describe a number of warranty cost factors that are useful in analyzing the cost-effectiveness of required warranties from a life-cycle-cost perspective. Table 7-4 presents major categories of these cost factors with summary descriptions.

7.6 WARRANTY BENEFITS

The benefits associated with a warranty must be identified and defined. Benefits may be qualitative as well as quantitative; for example, a warranty extends the contractor's responsibility to operational or field performance for the duration of the warranty. A well-constructed warranty can provide increased assurance that operational performance will be as specified. In some cases this assurance can be quantified through the use of reliability and maintainability parameters such as MTBF and MTTR. This is particularly true when the warranty includes guaranteed performance levels of such parameters. For example, increased reliability means fewer failures. The number of failures influences sparing levels, maintenance manpower levels, materials costs for repair, and other logistics and support elements associated with failures. Consequently, these types of warranty benefits can be translated into statistical measures of benefits and associated costs that can be used in the conduct of a cost-benefit analysis.

Benefits may not always be quantifiable in terms of direct cost savings. Such benefits may include motivation for:

- Emphasizing quality engineering in system design
- Using the warranty requirements as a way to "screen" contractors who are not capable of producing systems with reliable performance
- Focusing measurements of system performance in the *field* through warranties instead of through the development environment
- Resolving problems early and rapidly, with incentives for no-cost engineering change proposals
- Providing realistic estimates of field performance during proposal negotiations

It is recommended that the nonquantifiable benefits be identified in precise terms and compared to the required resources so that the decision maker can identify the most cost-effective alternative.

TABLE 7-4

WARRANTY COST FACTORS

Category	Cost Factors
Reliability	MTBF, MTBR, and reliability growth
Maintainability	False-pull rate, false-return rate, and repair time
Readiness	Availability and consignment spares
Logistics Flow	Pipeline and storage times, turnaround time, and spare quantities
Initial Acquisition Cost	Unit cost, test equipment cost, training cost, and data cost
Support Cost	Support cost per operating hour, spares cost, field maintenance cost, warranty administration cost, shipping cost, and facility cost
Contract Price Adjustment	Operate time adjustment, turnaround time adjustment, unverified failure adjustment, noncovered warranty failure, and warranty escalation costs
Transition Cost	Facility cost, retraining cost, test equipment cost, and inventory cost

7.7 AVAILABLE DoD WARRANTY COST MODELS

There is no DoD warranty cost-estimation model that addresses all the warranty requirements of 10 USC 2403. Specifically, current DoD models do not fully address aspects of both essential performance requirements and engineering redesign. The redesign responsibility placed on the contractor can be viewed as the most effective remedy available to achieve the required performance requirements of 10 USC 2403. This viewpoint is clearly defined by Army policy (Reference 17).

Since 1975, several DoD warranty cost models have been developed for analyzing the life-cycle costs associated with military warranties, including the following:

- Army Warranty Model (WARM) (Reference 18)
- PPAC Life-Cycle-Cost/Cost Breakdown Structure Model (References 19 and 20)
- Air Force Reliability Improvement Warranty (RIW) Model (Reference 3)

Although these models do not fully address the warranty requirements in 10 USC 2403, they can support warranty cost-benefit analyses with certain limitations. Cost analysts will need to supplement these cost models with algorithms and cost equations that address the essential performance warranty requirements of the law—primarily the cost issues in engineering redesign. These three cost models are described in the following subsections.

7.7.1 Army WARM Model

WARM is an available DoD bottom-up accounting model (from U.S. Army Aviation Systems Command) developed primarily for avionics systems application. It is computerized and available on dial-up service.

The objective of the model is to provide the user (cost analyst, contracting officer) with an analytical ap-

proach to conducting the quantitative cost-effectiveness analysis of warranties. The model provides:

- A "should cost" on a warranty
- Cost-effective analysis, with warranty and without warranty
- Risk and sensitivity analysis, depicting random fluctuations in the number of warranted failures

WARM evaluates the number of warranted failures according to the given distribution of MTBF and generates the warranty price that the contractor should be paid to fix the expected number of warranted failures. An MTBF can be derived from the failure factor (FF) commonly found in provisioning master records (PMRs). The model further computes the Government's in-house costs with or without a warranty to derive the total costs, and compares the alternatives.

The current version of WARM includes the probability distribution of achieved MTBFs and the total costs, as well as graphical representations such as probability versus MTBF, probability versus cost, and cost versus MTBF. The model allows the user to conduct sensitivity analyses and risk assessments. The user provides three levels of MTBF—low MTBF, high MTBF, and the MTBF mode. The user has the choice of assuming a triangular probability distribution of MTBFs or a Weibull distribution, whichever might better fit the situation. WARM then generates a probability distribution (triangular or Weibull) from the input MTBFs. WARM shows the expected total cost to the Government with and without a warranty, and its corresponding probability or confidence interval. The user is allowed to change a certain percentage of the total cost to see the change in confidence interval.

Reference 18 provides detailed instructions on input and on analysis and interpretation of the model. The reference also includes a sample run to demonstrate the capabilities of the model.

7.7.2 PPAC Life-Cycle-Cost/Cost Breakdown Structure Model

The PPAC model is computerized and available on dial-up service for DoD users. It is based on the LCC-2A model, a bottom-up accounting model developed for the Air Force in 1976. The PPAC model is part of a system that includes tutorial, library, analysis, and tailoring subsystems. The objective of the system is to provide the user with a tool for analyzing the impact of a selected PPA on program costs from a life-cycle perspective. The model is intended to be used:

- To determine whether it is cost-effective to implement a PPA on the program—that is, to compare each PPA option with the option of not having a PPA
- To compare the various PPA alternatives with one another
- To provide a structure for performing trade-off studies such as reliability versus maintainability or two-level versus three-level maintenance

The PPAC model is a set of equations and algorithms for estimating acquisition, investment, and recurring cost elements relevant to a PPA application. A cost breakdown structure is used in the model application to identify the cost elements relevant to the PPA under consideration. The model considers reliability growth and MTBF improvements in its evaluation. Reference 19 describes the algorithms and equations of the cost model as well as procedures for using the cost estimates from the model in warranty economic analysis. The reference includes a sample run to demonstrate the capabilities of the model.

7.7.3 Air Force RIW Model

The Air Force RIW model is an available DoD bottom-up accounting model (from Rome Air Development Center) developed primarily for electronic systems. The objective of the Air Force RIW model is to provide a means for evaluating the life-cycle costs of an RIW program as an aid in developing an effective warranty procurement. The model compares life-cycle cost under a totally organic maintenance concept with life-cycle cost under an RIW. Because of the comparative nature of the model, total life-cycle costs are not calculated. Specifically, the model does not consider those costs which are believed not to vary with respect to the support concepts, such as costs of installation and standard operation (e.g., power or fuel consumption).

The model assumes that MTBF is an adequate measure of equipment reliability and that, for the population existing at any given time, the exponential distribution is an appropriate description of the failure pattern. However, the MTBF can vary over equipment life because of reliability growth. The RIW model includes a reliability-growth model developed for warranty economic analysis.

The RIW model provides a comprehensive set of

algorithms and equations for the calculation of warranty price. This capability allows the user to estimate a fair and reasonable value for warranty price before performing a complete warranty cost-benefit analysis from a life-cycle perspective. Warranty price calculations use the generic form shown in the equation below. Reference 3 describes this equation in detail and presents more complex, second-level equations and submodels for calculating the major cost elements. Reference 3 also provides detailed instructions on input and on analysis and interpretation of the model. The reference includes a sample run to demonstrate the capabilities of the model and a complete computer listing for the model.

$$\begin{aligned}\text{RIW price} = [&(\text{fixed direct costs}) + (\text{other yearly costs}) \times (\text{number of years}) \times (\text{discount factor}) \\ &+ (\text{cost per repair}) \times (\text{expected number of repairs}) \times (\text{discount factor}) \\ &+ (\text{cost per good return}) \times (\text{expected number of good returns}) \times (\text{discount factor}) \\ &+ (\text{warranty data and administration costs}) \times (\text{discount factor})] \times (\text{risk factor}) \times (\text{profit factor})\end{aligned}$$

Chapter Eight
CASE EXAMPLES

This chapter briefly reviews some of the early experiences with the more extensive forms of warranty and presents a summary of a number of more recent warranty programs representing the three major military services and most major system classes. The earlier programs are reviewed because they are the only ones for which enough operational data are available to assess the feasibility and effectiveness of military warranty programs.

8.1 SUMMARIES OF EARLY PROGRAMS

Reviews of a number of warranty programs begun during the 1970s have generally concluded that long-term warranties can provide significant improvements in operational performance (R&M).

Reference 21 describes an interim study of an F-16 reliability improvement warranty program. The program was the most comprehensive and complex warranty application ever attempted by the Department of Defense. It involved a prime contractor and four subcontractors in addition to the participation of four European countries. On the basis of available preliminary data, it was estimated that the Government would save more than $100 million by supporting nine critical LRUs through an RIW program instead of through Air Force organic maintenance. The MTBR for the nine LRUs as a group was estimated to be 18 hours as compared with a goal of 17 hours. The MTBF growth rate of the warranted LRUs, however, was not statistically different from the growth rate of a comparable nonwarranted group. It was concluded that the program objectives were being met (reliability goals were being achieved) and that both the Government and contractor would benefit financially.

Reference 22 reviews several warranty programs. The ARN-118 TACAN under warranty (RIW) was compared with the ARN-111 (no warranty) in F-15 applications. The ARN-118 showed much higher reliability, by a factor greater than 2 to 1. Savings of more than $2.4 million for the F-15 application were translated to an estimated return on the warranty investment of 520 percent. A review of the Carousel Inertial Navigation System warranty revealed that the achieved MTBF was 12 percent better than that guaranteed, resulting in a spares-cost avoidance of at least $2 million.

Data collected by ARINC Research Corporation compared field MBTF values under a warranty program with goal values, some of which were contractually guaranteed. Table 8-1 shows that the field reliability exceeded the goal value for all the programs tested but one (Air Force gyro). The data were developed over a period when field reliability for unwarranted systems often was much lower than was specified, predicted, or tested.

Although the results shown in Table 8-1 suggest that warranty programs provide a mechanism for achieving reliability equipment, there are several factors to consider:

- The data represent programs that were carefully selected for warranty application.
- Many of the warranty programs entailed fairly extensive forms of warranty, with a great deal of effort given to structuring the terms and conditions properly.
- Advertising that an equipment is to be warranted is one way to help ensure that contractor-proposed MTBF values are realistic. While this is beneficial, it can lead to misinterpretation of results when data from warranted equipment are compared with similar data from nonwarranted equipment. Without an expected warranty commitment, expected MTBF values often became inflated.

TABLE 8-1

RIW EXPERIENCE: FIELD VERSUS GOAL MTBF

Equipment	Service	Contract Date	MTBF (Hours)		Ratio (Field to Goal)
			Field	Goal	
Gyro	Navy	1967	531	520	1.02
Gyro	Air Force	1969	1,000	1,300	0.77
Pump	Navy	1973	1,100	600	1.82
VOR/ILS	Army	1974	800*	700**	1.14
Pump	Air Force	1975	8,500	5,000	1.69
TACAN	Air Force	1975	1,482	800**	1.85
Klystron	Air Force	1975	3,780	1,000	3.85
INS	Air Force	1975	1,261	1,090**	1.16
AHRS	Air Force	1975	2,943	1,285**	2.27
Omega	Air Force	1967	769	700**	1.10
Transmitter	Air Force	1977	310	238**	1.47
HUD	Air Force	1977	826	325**	2.56
LDNS	Army	1977	600	500**	1.20

*Estimated.
**Guaranteed by contract.

8.2 SUMMARIES OF RECENT PROGRAMS

All but one of the programs presented in this section are relatively new and have limited field experience. Since passage of the 1984 law, hundreds of procurements have been contracted; presumably, most comply with the statutory regulation. Unfortunately, there is very little field experience to assess the workability and effectiveness of the warranty provisions. The lack of relevant data makes evaluation of warranties difficult. A recent Air Force PPAC study assessing the effectiveness of Air Force RIW programs provided some findings on the data problems (Reference 22):

- Administration and tracking of warranted items vary from program to program.
- Warranty programs are diverse in the amount of reporting and relevant data available to accomplish an adequate assessment.
- Most warranty programs do not undergo the pre-RIW analyses (trade studies and cost-benefit analyses) necessary to determine the best way to apply a warranty.

In light of these findings, the reported effectiveness of warranty should be viewed with caution, and it should be recognized that the documentation and collection of warranty data has not been uniform, thereby impeding direct comparison and conclusions.

The following tables provide summaries of warranty programs:

- Table 8-2—Navy Mine Neutralization System
- Table 8-3—Army Apache AH-64A Helicopter
- Table 8-4—Army M16 A2 Rifle, 5.56mm
- Table 8-5—Air Force Alternate Fighter Engine Program
- Table 8-6—Air Force F-15 Air Vehicle
- Table 8-7—Air Force ARN-118(V) TACAN

TABLE 8-2

NAVY MINE NEUTRALIZATION SYSTEM

Background

Procurement Organization:	Naval Sea Systems Command
Contract Date:	July 1984
Price of Warranted Items:	$24,909,272
Warranty Price:	$498,186
Production Phase:	Initial
Warranty Period:	3 years for material and workmanship and for design and manufacturing/performance

Remedies for Correcting Defects

Contractor repairs or replaces defective parts. Contractor corrects defects by redesign. Contractor reimburses the Government for the cost of repair and parts replacement if the contractor fails to repair or replace promptly. Contractor bears transportation costs.

Basic Warranty Language

Notwithstanding inspection and acceptance, the Contractor guarantees that:

(a) Specified components are designed and manufactured to conform to the performance requirements described in the weapon system specification.
(b) Specified components, at the time of acceptance, are free from defects in material and workmanship which would cause components to fail to conform to the performance requirements of this contract.

Notwithstanding any provision of the contract, the Contractor is responsible for preparing Engineering Change Proposals (ECPs) and for all aspects of implementing ECPs required to correct deficiencies.

Essential Performance Guarantee

Requirements:	Weapon specification examples include depth, neutralization rate, detection range, and reliability.
Validation Means:	Specifications, first article test, factory acceptance test, environmental stress tests, Sea Board trial, test and monitoring of system prior to and after acceptance, but prior to use.

TABLE 8-3

ARMY APACHE AH-64A HELICOPTER

Background

Procurement Organization:	U.S. Army Aviation Command
Conract Date:	9 April 1985
Price of Warranted Items:	$666,358,898
Warranty Price:	No cost except administration ($274,000 FY 1985)
Production Phase:	FSP - 4th year
Warranty Period:	2 years or 240 flight hours, whichever occurs first, for materiel and workmanship, essential performance, and design and manufacturing

Remedies for Correcting Defects

Contractor repairs or replaces failed depot components of 138 aircraft after the 3,183rd allowable failure up to liability cap of $21M. Contractor reimburses the Government for repair or replacement of any parts due to defects in materiel and workmanship that occur on a lot basis. Contractor reimburses the Government for the cost of repair and replacement if the contractor fails to repair or replace promptly. Contractor does not bear transportation costs.

Basic Warranty Language

Coverage: Notwithstanding inspection and acceptance by the Government of supplies furnished under this contract or any provision of this contract concerning the conclusiveness thereof, the Contractor warrants, for the period set forth in para c, that any aircraft, procured under this contract, including all warranted components and lot defects on non-depot repairable parts installed on such aircraft;

(1) Will meet performance requirements specified in this Warranty Clause.
(2) Will be free from all defects in material and workmanship at the time of delivery that would cause the warranted items to to fail to meet any performance requirements specified in this Warranty Clause.
(3) Will conform to the design and manufacturing requirements set forth in Section C.1 of this contract, consistent with the contractor's approved Quality Assurance System.

Liability: The contractor shall be liable for all failures and direct and resultant damage caused thereby, not excluded from coverage, to the extent set out in this clause and not otherwise limited herein or elsewhere in this contract. The contractor's obligation under this clause shall be to repair or to absorb the cost of repair of failed warranted components beginning with the 3,184 repair. Contractor's maximum liability shall not exceed $21,000,000. Included within this limited liability is a separate $1,000,000 limitation on resultant damages as defined herein.

Essential Performance Guarantee

Requirements:	Contained in technical manuals for operation and maintenance with failure rates no greater than allowed by the AH-64A system specification MTBF. Evidence of failures of depot-repairable assemblies must not exceed 3,183 failures from the 138 warranted aircraft. All parameters are related to field performance checks such as rate of climb, gauge readings, or satisfactory maintenance tests.
Validation Means:	Operation and maintenance checks.

TABLE 8-4

ARMY M16 A2 RIFLE, 5.56mm

Background

Procurement Organization:	U.S. Army Armament, Munitions and Chemical Command
Contract Date:	August 1985
Price of Warranted Items:	$53,108,510 (116,722 units @ $455)
Warranty Price:	No cost
Production Phase:	FSP - 4th year (of A2 version)
Warranty Period:	1 year for materiel and workmanship, essential performance, and design and manufacturing

Remedies for Correcting Defects

Contractor takes corrective action for defective parts when failures of any lot exceed 7-1/2 percent of lot quantity. Contractor liability as a minimum requires reimbursement for defective parts but may also require lot corrective action. Contract price reduction may be made by Government decision to either not correct or partially correct defect. Contractor bears transportation costs.

Basic Warranty Language

Specific Warranties. The contractor hereby warrants --

(1) Design/Manufacturing Conformance Warranty.

For one year, that line item 0001, will conform to all design and manufacturing requirements specifically delineated in this contract (including, but not limited to, all specifications and statements of work), and in any amendments thereto. Design and manufacturing requirements include, but are not limited to, all structural and engineering plans and manufactured particulars, including, but not limited to, precise measurements, tolerance, materiels, processes and finished product tests for the item being produced. Allowance shall be made for reasonable wear and tear.

(2) Material and Workmanship Warranty.

For one year, that line item 0001 at the time of delivery, is free from all defects in materials and workmanship.

(3) Essential Performance Warranty.

For one year, that line item 0001 will conform to the essential performance requirements for such items as specifically delineated in this contract and in any amendments thereto. Allowance shall be made for reasonable wear and tear. For purposes of this warranty, the essential performance requirements are delineated as follows for head space, firing pin indent, functioning, targeting and accuracy.

Essential Performance Guarantee

Requirements:	Parameters directly related to field operation: Head space (chamber length) and firing pin indent (energy and centering of firing pin on cartridge) are measurements. Functioning is a serviceability observation/ demonstration by the rifle user. Targeting and accuracy are operational requirements that are determined on the firing range by the rifle user.
Validation:	Operation by the rifle user and maintenance measurements by the unit armorer.

TABLE 8-5

AIR FORCE ALTERNATE FIGHTER ENGINE PROGRAM (F110-100 ENGINE)

Background

Procurement Organization:	Air Force, Aeronautical Systems Division
Contract Date:	December 1984
Warranty Price:	$27,075,510
Production Phase:	Initial
Warranty Period:	Varies; see Basic Warranty Language

Remedies for Correcting Defects

Contractor repairs or replaces defective parts. Contractor reimburses the Government for the cost of repair and parts through an equitable downward adjustment in contract price. Contractor is assessed liquidated damages for delay in repair and provides a new engine in the event of aircraft loss directly attributable to the engine.

Basic Warranty Language

The Contractor warrants that at the time of acceptance and for a period of three (3) years thereafter or for 1000 engine flight hours, whichever occurs first, each engine (i) shall be free from defects in material and workmanship; and (ii) shall be free from any condition rendering the engine unusable and/or unserviceable or causing it to operate other than in accordance with applicable T.O. limits. Any such conditions shall be considered defective, even though tests at contractor's plant reveal otherwise. Similar provisions for each of the modules, components, and serialized parts of the engine. Support equipments warranted for three years. The Contractor warrants that the performance of each engine delivered under this contract for a period of 3000 total accumulated cycles, shall (i) not be less than 98% of the intermediate thrust as set forth in specification; (ii) shall not exceed 105% of the intermediate specific fuel consumption (SFC) as set for in the specification. With respect to (i) and (ii), performance shall be determined by Engine Monitoring System (EMS) and may be determined by the Government on either (1) an installed basis or (2) and uninstalled basis appropriately corrected to the installed condition. Additional warranties included on engineering removal rate and combuster and/or high pressure turbine.

Essential Performance Guarantee

Requirements:	Included in warranty provisions: Not to be less than 98 percent of the specified intermediate thrust and not to exceed 105 percent of the specified intermediate specific fuel consumption.
Validation:	Performance determined by engine monitoring system and combined engine removal rate.

TABLE 8-6

AIR FORCE F-15 AIR VEHICLE

Background

Procurement Organization:	Air Force, Aeronautical Systems Division
Contract Date:	March 1985
Warranty Price:	$2,900,000 (estimated)
Production Phase:	Follow-on (initial production January 1970)
Warranty Period:	6 months (defects in design); 12 months (materials and workmanship

Remedies for Correcting Defects

Contractor corrects or partially corrects defects at written direction from the contracting officer. Contract price is reduced for partial correction or noncorrection. Contractor reimburses the Government for correction or replacement of design defects, not to exceed in the aggregate $3,930,516. Contractor bears transportation costs.

Basic Warranty Language

Supplies furnished under this contract are designed and manufactured to conform to the specified performance requirements delineated in SOW as relating to the Part I specifications for performance guarantee. Supplies furnished, at the time of delivery, are free from defects in material and workmanship and will conform with special provision 551/M of F33657-84-C-2131 on fabrication requirements for aircraft manufacture acceptance. As to support equipment, fabrication requirements as listed in the Priced Aerospace Ground Equipment List are attached to this contract.

Essential Performance Guarantee

Requirements:	Contained in classified specifications. Examples include speed, take-off/landing distance, and specific excess power.
Validation:	Acceptance tests and operational use.

TABLE 8-7

AIR FORCE ARN-118(V) TACAN

Background

Procurement Organization:	Air Force, Electronic Systems Division
Contract Date:	July 1975
Price of Warranted Items:	$72,023,206
Warranty Price:	$12,506,985
Production Phase:	Initial
Warranty Period:	4 years (RIW and MTBF guarantee)

Remedies for Correcting Defects

Under RIW, contractor repairs or replaces every covered failure. Under MTBF guarantee, contractor determines causes of nonconforming MTBF, develops and implements corrective action, and provides consignment spares in the interim.

Basic Warranty Language

Under RIW, the system will be free from defects in design, material, and workmanship, and will operate in its intended environment in accordance with contractual specifications and for the warranty period set forth in the contract. Under MTBF Guarantee, the system will achieve a MTBF value equal or greater than the following: 500 hours (1 through 12 months), 625 hours (13 through 24 months), and 800 hours (25 through 48 months).

Essential Performance Guarantee

Requirements:	MTBF.
Validation:	Operate time is measured by elapsed-time indicators, and failures are those covered under the RIW.
Results:	Final results show that system MTBF exceeded 1,000 hours, well above the highest guarantee value. Warranty administration worked well, and the warranty program is considered a model RIW program.

Appendix A
GLOSSARY OF TERMS

Acceptance—The act of an authorized representative of the Government by which the Government, for itself or an agent of another, assumes ownership of existing identified supplies tendered or approves specific services rendered as partial or complete performance of the contract.

Assurance warranty—A warranty form consistent with 10 USC 2403 that is designed to assure that minimum required design, quality, and performance levels are achieved. There is no built-in incentive for the contractor to exceed minimum levels.

Availability guarantee—A contractual guarantee that the availability of operational systems will meet a stated level when measured in accordance with stipulated procedures.

Commercial supplies—Equipment or supplies that normally are sold or offered to the public commercially by a supplier (frequently referred to as off-the-shelf items).

Correction—Elimination of a defect.

Cost-benefit analysis—The process used to compare the total costs of a warranty with the benefits to be derived from the warranty.

Defect—Any condition or characteristic in any supplies or services furnished by the contractor under the contract that is not in compliance with the requirements of the contract.

Design and manufacturing requirements—Structural and engineering plans and manufacturing particulars, including precise measurements, tolerances, materials, and finished product tests for the weapon system being produced.

Essential performance requirements—Operating capabilities and reliability and maintenance characteristics of a weapon system that are determined by the Secretary of Defense (or delegated authority) to be necessary for the system to fulfill the military requirement for which it is designed.

Foreign military sales—The selling of United States-produced *military equipment* and services to friendly foreign governments under the authority of the Foreign Assistance Act of 1961, as amended.

Government-furnished property—Property in the possession of, or acquired directly by, the Government and subsequently delivered or otherwise made available to the contractor.

Incentive warranty—A warranty form that provides incentives for the contractor to exceed minimum design, quality, or performance levels.

Initial production quantity—The number of units of a weapon system contracted for in the first program year of full-scale production.

Inspection—Examination and testing of supplies or services (including, when appropriate, raw materials, components, and intermediate assemblies) to determine whether they conform to contract requirements.

Latent defect—A defect that exists at time of acceptance that is not normally detected through routine inspection and that manifests itself after acceptance.

Life-cycle cost—The total cost to the Government for acquiring, operating, and supporting a system over its lifetime.

Logistics support cost guarantee—A contractual

guarantee that the logistics support cost of a population of systems will not exceed a stated value when measured and calculated in accordance with stipulated procedures.

Mature full-scale production – Follow-on production of a weapon system after manufacture of the lesser of the initial production quantity or one-tenth of the eventual total production quantity.

Mean time between failures guarantee – A contractual guarantee that fielded or field-tested systems will exhibit a stated MTBF level when measured in accordance with stipulated procedures.

Prime contractor – Party that enters into an agreement directly with the United States to furnish a system or a major subsystem.

Product performance agreement – A management tool designed to increase the contractor's responsibility for the field performance of a product.

Redesign remedy – Warranty remedy that requires the contractor to redesign the product to correct a deficiency.

Reliability – Characteristic of a system or equipment that describes its ability to perform without failure. Reliability is usually expressed in terms of mean time between failures (MTBF) or probability of mission success.

Reliability improvement warranty – A fixed-price contractual commitment for a contractor to provide depot repair services as part of a long-term warranty, thereby providing an inherent incentive to correct problems and improve reliability.

Turnaround time – The time from receipt of a warranted item at the contractor's repair facility to completion of the repair and sign-off by the authorized Government representative.

Warranty – A promise or affirmation given by a contractor to the Government regarding the nature, usefulness, or condition of the supplies or performance of services furnished under the contract.

Warranty administration – Activities conducted to prepare for, implement, and terminate the warranty.

Warranty breach – Failure to meet the warranty terms and conditions.

Warranty duration – The coverage period for the warranty; may be on an item, lot, or total production quantity basis.

Warranty extension – Continuation or modification of the warranty when the current warranty is about to expire.

Warranty implementation plan – A plan that defines warranty responsibilities, identifies responsible participants, and establishes warranty interface and implementation procedures.

Warranty price – The price paid to the contractor for providing the warranty. In cases where a separate contractual line item for warranty does not exist, warranty price may have to be estimated.

Warranty remedy – Actions of a contractor to meet its obligations under the terms of the warranty when a warranty defect occurs.

Warranty risk – Risks associated with the warranty commitment.

Warranty transition – Events related to ending a warranty. Transition may entail a change in maintenance structure.

Warranty waiver – A variance from meeting the requirements of 10 USC 2403 because of national security interests or because a warranty would not be cost-effective.

Weapon system – System or major subsystem used directly by the armed forces to carry out combat missions.

Appendix B
LIST OF ACRONYMS AND ABBREVIATIONS

10 USC 2403	Title 10, Section 2403, of the United States Code
AG	Availability Guarantee
AR	Army Regulation
ASPR	Armed Services Procurement Regulation
BITE	Built-In-Test Equipment
C^3	Command, Control, and Communications
CLIN	Contract Line Item Number
COD	Correction of Deficiencies
DCAS	Defense Contract Administration Services
DFARS	Defense Federal Acquisition Regulation Supplement
DID	Data Item Description
DoD	Department of Defense
ECP	Engineering Change Proposal
EW	Electronic Warfare
FAR	Federal Acquisition Regulation
FF	Failure Factor
FFW	Failure-Free Warranty
FMS	Foreign Military Sales
FSD	Full-Scale Development
GFE	Government-Furnished Equipment
GFM	Government-Furnished Material
GFP	Government-Furnished Property
JAG	Judge Advocate General
LCC	Life-Cycle Cost
LRU	Line Replaceable Unit
LSC	Logistics Support Cost
LSCG	Logistics Support Cost Guarantee
MACOM	Major Command
MAT DEV	Materiel Developer
MDT	Mean Downtime
MFP	Materiel Fielding Plan
MFT	Materiel Fielding Team
MIL-STD	Military Standard
MLSC	Measured Logistics Support Cost
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
MTBF	Mean Time Between Failures
MTBFG	Mean Time Between Failures Guarantee
MTBR	Mean Time Between Removals or Replacements
MTTR	Mean Time to Repair
OSD	Office of the Secretary of Defense
P^3I	Preplanned Product Improvement
PCO	Procurement Contracting Officer
PMR	Provisioning Master Record
PPA	Product Performance Agreement
PPAC	Product Performance Agreement Center
QA	Quality Assurance
R&M	Reliability and Maintainability
RFP	Request for Proposal
RIW	Reliability Improvement Warranty
RTOK	Retest Okay
SECNAVINST	Secretary of the Navy Instruction
SOA	State of the Art
SRU	Shop Replaceable Unit
TACAN	Tactical Air Navigation

TEMP	Test and Evaluation Master Plan
TLSC	Target Logistics Support Cost
T.O.	Technical Order
WARCO	Warranty Control Office or Officer
WARM	Warranty Model (Army)
WCB	Warranty Cost-Benefit
WRA	Weapon Replaceable Assembly
WTB	Warranty Technical Bulletin

Appendix C
TITLE 10, SECTION 2403, OF THE UNITED STATES CODE

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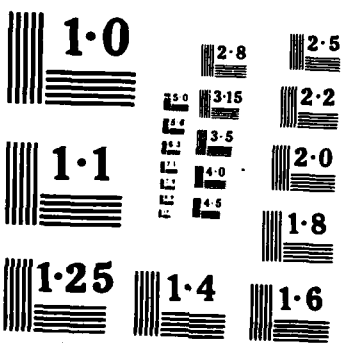
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§ 2403. Major weapon systems: contractor guarantees

(a) In this section:

(1) "Weapon system" means items that can be used directly by the armed forces to carry out combat missions and that cost more than $100,000 or for which the eventual total procurement cost is more than $10,000,000. Such term does not include commercial items sold in substantial quantities to the general public.

(2) "Prime contractor" means a party that enters into an agreement directly with the United States to furnish part or all of a weapon system.

(3) "Design and manufacturing requirements" means structural and engineering plans and manufacturing particulars, including precise measurements, tolerances, materials, and finished product tests for the weapon system being produced.

(4) "Essential performance requirements", with respect to a weapon system, means the operating capabilities or maintenance and reliability characteristics of the system that are determined by the Secretary of Defense to be necessary for the system to fulfill the military requirement for which the system is designed.

(5) "Component" means any constituent element of a weapon system.

(6) "Mature full-scale production" means the manufacture of all units of a weapon system after the manufacture of the first one-tenth of the eventual total production or the initial production quantity of such system, whichever is less.

(7) "Initial production quantity" means the number of units of a weapon system contracted for in the first year of full-scale production.

(8) "Head of an agency" has the meaning given that term in section 2302 of this title.

(b) Except as otherwise provided in this section, the head of an agency may not after January 1, 1985, enter into a contract for the production of a weapon system unless each prime contractor for the system provides the United States with written guarantees that—

(1) the item provided under the contract will conform to the design and manufacturing requirements specifically delineated in the production contract (or in any amendment to that contract);

(2) the item provided under the contract, at the time it is delivered to the United States, will be free from all defects in materials and workmanship;

(3) the item provided under the contract will conform to the essential performance requirements of the item as specifically delineated in the production contract (or in any amendment to that contract); and

(4) if the item provided under the contract fails to meet the guarantee specified in clause (1), (2), or (3), the contractor will at the election of the Secretary of Defense or as otherwise provided in the contract—

(A) promptly take such corrective action as may be necessary to correct the failure at no additional cost to the United States; or

(B) pay costs reasonably incurred by the United States in taking such corrective action.

(c) The head of the agency concerned may not require guarantees under subsection (b) from a prime contractor for a weapon system, or for a component of a weapon system, that is furnished by the United States to the contractor.

(d) Subject to subsection (e)(1), the Secretary of Defense may waive part or all of subsection (b) in the case of a weapon system, or component of a weapon system, if the Secretary determines—

(1) that the waiver is necessary in the interest of national defense; or

(2) that a guarantee under that subsection would not be cost-effective.

The Secretary may not delegate authority under this subsection to any person who holds a position below the level of Assistant Secretary of Defense or Assistant Secretary of a military department.

(e)(1) Before making a waiver under subsection (d) with respect to a weapon system that is a major defense acquisition program for the purpose of section 189a of this title, the Secretary of Defense shall notify the Committees on Armed Services and on Appropriations of the Senate and House of Representatives in writing of his intention to waive any or all of the requirements of subsection (b) with respect to that system and shall include in the notice an explanation of the reasons for the waiver.

(2) Not later than February 1 of each year, the Secretary of Defense shall submit to the committees specified in paragraph (1) a report identifying each waiver made under subsection (d) during the preceding calendar year for a weapon system that is not a major defense acquisition program for the purpose of section 139a of this title and shall include in the report an explanation of the reasons for the waivers.

(f) The requirement for a guarantee under subsection (b)(3) applies only in the case of a contract for a weapon system that is in mature full-scale production. However, nothing in this section prohibits the head of the agency concerned from negotiating a guarantee similar to the guarantee described in that subsection for a weapon system not yet in mature full-scale production. When a contract for a weapon system not yet in mature full-scale production is not to include the full guarantee described in subsection (b)(3), the Secretary shall comply with the notice requirements of subsection (e).

(g) Nothing in this section prohibits the head of the agency concerned from—

(1) negotiating the specific details of a guarantee, including reasonable exclusions, limitations and time duration, so long as the negotiated guarantee is consistent with the general requirements of this section;

(2) requiring that components of a weapon system furnished by the United States to a contractor be properly installed so as not to invalidate any warranty or guarantee provided by the manufacturer of such component to the United States;

(3) reducing the price of any contract for a weapon system or other defense equipment to take account of any payment due from a contractor pursuant to subclause (B) of subsection (b)(4);

(4) in the case of a dual source procurement, exempting from the requirements of subsection (b)(3) an amount of production by the second source contractor equivalent to the first one-tenth of the eventual total production by the second source contractor; and

(5) using written guarantees to a greater extent than required by this section, including guarantees that exceed those in clauses(1), (2), and (3) of subsection (b) and guarantees that provide more comprehensive remedies than the remedies specified under clause (4) of that subsection.

(h)(1) The Secretary of Defense shall prescribe such regulations as may be necessary to carry out this section.

(2) This section does not apply to the Coast Guard or to the National Aeronautics and Space Administration.

(Added Pub.L. 98-525, Title XII, § 1234(a), Oct. 19, 1984, 98 Stat. 2601.)

Prior Provisions. Provisions similar to this section were contained in Pub.L. 98-212, Title VII, § 794, Dec. 8, 1983, 97 Stat. 1454 (set out as a note under section 2304 of this title) prior to repeal of the section by section 1234(b)(1) of Pub.L. 98-525, effective Jan. 1, 1985.

Legislative History. For legislative history and purpose of Pub.L. 98-525, see 1984 U.S. Code Cong. and Adm. News, p. 4174.

Appendix D

DEFENSE FEDERAL ACQUISITION REGULATION SUPPLEMENT (DFARS) SUBPART 46.7

This appendix presents the latest version of DFARS Subpart 46.7, which was issued during final production of this handbook. Text in the handbook refers to the earlier version of the DFARS, which is quite similar to the version presented here.

46.701 Definitions.

"Acceptance," as used in this subpart and in the warranty clauses at FAR 52.246-17, Warranty of Supplies of a Noncomplex Nature; FAR 52.246-18, Warranty of Supplies of a Complex Nature; FAR 52.246-19, Warranty of Systems and Equipment under Performance Specifications or Design Criteria; and FAR 52.246-20, Warranty of Services; means the execution of an official document (e.g., DD Form 250) by an authorized representative of the Government. The above clauses shall be modified accordingly in DoD contracts.

"Defects," as used in this subpart, means any condition or characteristic in any supplies or services furnished by the contractor under the contract that is not in compliance with the requirements of the contract.

46.702 General.

(d) Planning is an essential step in obtaining an effective warranty. To be effective, warranties should be implemented as an integral part of an overall design, development, test, and production program.

(e) The acquisition cost of a warranty may be included as part of an item's price or may be set forth as a separate contract line item.

(f) Agencies shall establish procedures to track and accumulate data relative to warranty costs.

46.703 Criteria for Use of Warranties.

The use of warranties in the procurement of weapon systems is mandatory pursuant to 10 USC 2403, unless a waiver is authorized. Policy and procedures for obtaining such warranties or waivers are contained in 46.770. Acquisition of warranties in the procurement of supplies that do not meet the definition of a weapon system (e.g., spare, repair, or replenishment parts) is governed by FAR 46.7.

46.704 Authority for Use of Warranties.

In contracts for other than weapon systems, the Chief of the Purchasing Office must approve use of a warranty except for:

(a) commercial supplies or services (see FAR 46.709);

(b) technical data, unless the warranty provides for extended liability (see 46.708);

(c) supplies and services in fixed price type contracts containing quality assurance provisions that reference MIL-I-45208 or MIL-Q-9858; and

(d) supplies and services in construction contracts when the warranties contained in Federal, military or construction guide specifications applicable to a given construction project are used. Authority for use of warranties in the procurement of weapon systems is stated in 46.770.

46.705 Limitations.

(a) Except for contracts for the production of weapon systems under 46.770, contracting officers shall not include warranties in cost-reimbursement contracts, except for those warranties contained in the clauses at FAR 52.246-3, Inspection of Supplies—Cost-Reimbursement; FAR 52.246-8, Inspection of Research and Development—Cost-Reimbursement; and at 52.246-7001, Warranty of Technical Data.

46.706 Warranty Terms and Conditions.

(b)(5) Markings. If items delivered under the contract shall be stamped or marked, it shall be done so in accordance with MIL Standard 129, "Marking for Shipments and Storage" and MIL Standard 130, "Identification Marking of U.S. Military Property." 46.708 Warranties of Technical Data.

A warranty of technical data should be obtained whenever practicable and cost effective. The contracting officer shall consider the factors contained in FAR 46.703 in deciding whether to provide for warranties of technical data and whether there should be an extended liability provision (see 46.770-10). Particular emphasis should be placed on whether the extended liability is justified by (i) the likelihood that correction or replacement of the nonconforming data, or a price adjustment in lieu thereof, will not afford adequate protection to the Government; and (ii) the effectiveness of the additional remedy as a deterrent against furnishing nonconforming data.

46.710 Contract Clauses.

(f) In accordance with 46.708, the contracting officer may insert a clause substantially the same as the clause at 52.246-7001, Warranty of Data, in solicitations and contracts when a fixed-price or cost-reimbursement contract is contemplated that will require data to be furnished. When this clause is not

used, technical data is warranted under the clauses at FAR 52.246-3, Inspection of Supplies—Cost-Reimbursement; FAR 52.246-6, Inspection—Time and Material and Labor Hour; FAR 52.246-8, Inspection of Research and Development—Cost-Reimbursement; and FAR 52.246-19, Warranty of Systems and Equipment Under Performance Specifications or Design Criteria.

(1) If extended liability is desired and a fixed-price incentive contract is contemplated, the contracting officer may use the clause with its Alternate I.

(2) If extended liability is desired and a firm fixed-price contract is contemplated, the contracting officer may use the clause with its Alternate II.

46.770 Use of Warranties in Weapon System Procurements.

This section sets forth policy and procedures for obtaining, pursuant to 10 U.S.C. 2403, certain warranties from prime contractors when contracting for the production of a weapon system.

46.770-1 Definitions.

"At no additional cost to the United States," as used in this section, means at no increase in price for firm fixed price contracts or at no increase in target or ceiling price for fixed price incentive contracts (see also FAR 46.707) or at no increase in estimated cost or fee for cost-reimbursement contracts.

"Design and manufacturing requirements," as used in this section, means structural and engineering plans and manufacturing particulars, including precise measurements, tolerances, materials and finished product tests for the weapon system being produced.

"Essential performance requirements," as used in this section, means the operating capabilities and/or maintenance and reliability characteristics of a weapon system that are determined by the Secretary of Defense (or delegated authority) to be necessary for it to fulfill the military requirement for which the system is designed.

"Initial production quantity," as used in this section, means the number of units of a weapon system contracted for in the first program year of full-scale production.

"Mature full-scale production," as used in this section, means follow-on production of a weapon system after manufacture of the lesser of the initial production quantity or one-tenth of the eventual total production quantity.

"Prime contractor," as used in this section, means a party that enters into an agreement directly with the United States to furnish a system or a major subsystem.

"Weapon system," as used in this subpart, means a system or major subsystem used directly by the armed forces to carry out combat missions. By way of illustration, the term "weapon system" includes, but is not limited to the following, if intended for use in carrying out combat missions: tracked and wheeled combat vehicles; self-propelled, towed and fixed guns, howitzers and mortars; helicopters; naval vessels; bomber, fighter, reconnaissance and electronic warfare aircraft; strategic and tactical missiles including launching systems; guided munitions; military surveillance, command, control, and communication systems; military cargo vehicles and aircraft; mines; torpedoes; fire control systems; propulsion systems; electronic warfare systems; and safety and survival systems. This term does not include related support equipment, such as ground-handling equipment, training devices and accessories thereto; or ammunition, unless an effective warranty for the weapon system would require inclusion of such items. This term does not include commercial items sold in substantial quantities to the general public as described at FAR 15.804-3(c).

46.770-2 Policy.

(a) Unless waived under 46.770-9, after 1 January 1985, the Military Departments and Defense Agencies may not enter into a contract for the production of a weapon system with a unit weapon system cost of more than $100,000 or for which the eventual total procurement cost is in excess of $10,000,000, unless:

(1) a prime contractor for the weapon system provides the United States with written warranties that—

(i) the weapon systems provided under the contract conform to the design and manufacturing requirements specifically delineated in the contract (or any modification to that contract),

(ii) the weapon systems provided under the contract are free from all defects in materials and workmanship at the time of acceptance or delivery as specified in the contract; and

(iii) the weapon systems, if manufactured in mature full-scale production, conform to the essential performance requirements as specifically delineated in the contract (or any modification to that contract);

(2) the contract terms provide that, in the event the weapon system fails to meet the terms of the above warranties, the contracting officer may—

(i) require the contractor to promptly take such corrective action as necessary (repair, replace and/or redesign) at no additional cost to the United States,

(ii) require the contractor to pay costs reasonably incurred by the United States in taking necessary corrective action, or

(iii) equitably reduce the contract price.

(b) Contracting officers may require warranties that provide greater coverage and remedies than specified above, such as including an essential performance requirements warranty in other than a mature full-scale production contract.

46.770-3 Tailoring Warranty Terms and Conditions.

As the objectives and circumstances vary considerably among weapon system acquisition programs, contracting officers shall appropriately tailor the required warranties on a case-by-case basis, including remedies, exclusions, limitations, and durations; provided, such are consistent with the specific requirements of this section (see also FAR 46.706). The duration specified in any warranty should be clearly related to the contract requirements and allow sufficient time to demonstrate achievement of the requirements after acceptance. Contracting officers may exclude from the terms of the warranty certain defects for specified supplies (exclusions) and may limit the contractor's liability under the terms of the warranty (limitations), as appropriate, if necessary to derive a cost effective warranty in light of the technical risk, contractor financial risk, or other program uncertainties. All subsystems and components will be procured in such a manner so as not to invalidate the weapon system warranty. Contracting officers are encouraged to structure broader and more comprehensive warranties where such are advantageous and in accordance with agency policy. Likewise, the contracting officer may narrow the scope of a warranty where such is appropriate (e.g., where it would be inequitable to require a warranty of all essential performance requirements because a contractor had not designed the system). It is Department of Defense policy not to include in warranty clauses any terms that cover liability for loss, damage or injury to third parties.

46.770-4 Establishing Essential Performance Requirements.

The Secretary of Defense or heads of military departments, or delegees, shall designate which features of a weapon system are its essential performance requirements. Essential performance requirements may be subsequently modified, superseded or cancelled by the Secretary of Defense or heads of military departments (or delegees) when such is in the interests of the Government.

46.770-5 Warranties on Government-Furnished Property.

A prime contractor shall not be required to provide the warranties specified in 46.770-2 on any property furnished to that contractor by the United States except for (a) defects in installation, (b) installation or modification in such a manner that invalidates a warranty provided by the manufacturer of the property, or (c) modifications made to the property by the prime contractor.

46.770-6 Exemption for Alternate Source Contractor(s).

Agency heads may exempt alternate source contractor(s) from the essential performance warranty requirements of 46.770-2(a)(1)(iii) until that contractor manufactures the first 10% of the eventual total production quantity anticipated to be acquired from that contractor.

46.770-7 Applicability to FMS.

The warranty requirements of 46.770-2 are not mandatory for FMS production contracts. For all weapon systems procured for FMS requirements, the policy of the Department of Defense shall be to obtain the same warranties on conformance to design and manufacturing requirements and against defects in materials and workmanship that are obtained for U.S. supplies. DoD will not normally obtain essential performance warranties for FMS purchasers. However, where the cost for the warranty of essential performance requirements cannot be practically separately identified, the foreign purchaser may be provided the same warranty that is obtained on the same equipment purchased for the U.S. If the

FMS purchaser expressly requests a performance warranty in the Letter of Offer and Acceptance (LOA) the United States will exert its best efforts to obtain the same warranty obtained on U.S. equipment or, if specifically requested by the FMS purchaser, a unique warranty. It is anticipated that the costs for warranties for FMS purchasers may be different from the costs for such warranties for the United States due to such factors as overseas transportation and any tailoring to reflect the unique aspects of the FMS purchaser. Special care must be exercised to ensure that the FMS purchaser shall bear all of the acquisition and administration costs of any warranties obtained.

46.770-8 Cost-Benefit Analysis.

It is Department of Defense policy to only obtain warranties that are cost effective. If a specific warranty is considered not to be cost effective by the contracting officer, a waiver request shall be initiated under 46.770-9. In assessing the cost effectiveness of a proposed warranty, an analysis must be performed which considers both the quantitative and qualitative costs and benefits of the warranty. Costs include the warranty acquisition, administration, enforcement and user costs, weapon system life cycle costs with and without a warranty, and any costs resulting from limitations imposed by the warranty provisions. Costs incurred during development specifically for the purpose of reducing production warranty risks should also be considered. Similarly, the cost-benefit analysis must also consider logistical/operational benefits expected as a result of the warranty as well as the impact of the additional contractor motivation provided by the warranty. Where possible, comparison should be made with the costs of obtaining and enforcing similar warranties on similar systems. The analysis should be documented in the contract file.

46.770-9 Waiver and Notification Procedures.

One or more of the weapon system warranties required by 46.770-2 may be waived if such waiver is in the interests of national defense or if the warranty to be obtained would not be cost effective. Waivers may be granted by the Secretary of Defense, by the Assistant Secretary of Defense (Acquisition and Logistics) for Defense agencies without the power to redelegate, or by the Secretaries of the Army, Navy and Air Force with the power to redelegate to no lower than an Assistant Secretary of the Military Department. Class waivers may be granted where justified. Waivers may be granted provided the following notifications or reports are made to the Senate and House Committees on Armed Services and on Appropriations:

(a) Major Weapon Systems. With respect to a weapon system that is a major defense acquisition program for the purpose of 10 U.S.C. 139a, before granting a waiver, the waiving official shall notify the aforementioned Committees in writing of an intention to waive one or more of the required warranties. The notice of intent to waive shall include an explanation to the reasons for the waiver and shall include an explanation to the reasons for the waiver and shall ordinarily be given 30 days prior to granting such waiver.

(b) Other Weapon Systems. With respect to weapon systems that are not major defense acquisition programs for the purpose of 10 U.S.C. 139a, waiving officials shall submit an annual report not later than 1 February of each year that lists waivers granted on such programs during the preceding calendar year. This report shall also include an explanation of the reasons for granting each waiver.

(c) Weapon Systems not in Mature Full-Scale Production. Although a waiver is not required, if a production contract for a major weapon system not yet in mature full-scale production will not include a warranty on essential performance requirements, the waiving officials shall nonetheless comply with the notice requirements for major weapon systems.

(d) Processing Waivers, Notifications and Reports. Each Department shall issue procedures for processing waivers, notifications, and reports to Congress. At the minimum, these procedures shall specify:

(1) Requests for waiver shall include—

(i) A brief description of the weapon system and its stage of production, e.g., the number of units delivered and anticipated to be delivered during the life of the program; and

(ii) The specific warranty or warranties required by 46.770-2(a)(1) for which the waiver is requested, the duration of the waiver if it is to go beyond the instant contract, and rationale for the waiver.

(iii) A description of the warranties or other techniques to be employed to assure acceptable field performance of the weapon system.

(2) Notifications and reports shall include—

(i) A brief description of the weapon system and its stage of production, and

(ii) Rationale for not obtaining a warranty.

(3) A written record will be kept of each waiver granted and notification and report made, together with supporting documentation such as a cost-benefit analysis, for use in answering inquiries.

(4) A copy of each notification and report to Congress shall be submitted concurrently to the Assistant Secretary of Defense (Acquisition and Logistics). For Class waivers, this copy shall be submitted in advance of the transmittal to Congress.

46.770-10 Special Contract Clauses.

(a) In accordance with 46.770, the contracting officer shall insert in solicitations and contracts pertaining to the production of weapon systems a clause that describes the contractor's warranties on the weapon system.

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This [illegible] is designed to aid program managers in meeting the requirement [illegible] [illegible] the [illegible] of a warranty [illegible] contracts. The statutory requirements, associated DoD policy, and military [illegible] are reviewed. Warranty concepts and issues are described, including the two basic types of warranty: assurance and incentive. These warranty [illegible] the simpler warranty [illegible] from warranties designed to motivate the [illegible] minimum performance levels. Development activities considered include formulation [illegible] warranty acquisition strategy, developing warranty terms and conditions, conducting warranty cost-benefit analyses, and implementing and administering the warranty. Reviews of recent warranty applications are also included.

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